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on used oils &
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of Montana

Used Oil and Solvent Study for the State of Montana

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A Special Report

June 1987

Submitted to the
Montana Department of Health and Environmental Sciences
Solid and Hazardous Waste Bureau

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A SPECIAL REPORT ON USED OILS & SOLVENTS FOR STATE OF MONTANA

June 1987

Prepared For:

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Environmental Sciences
Solid and Hazardous Waste Bureau

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SECTION 1

BACKGROUND AND SUMMARY

SECTION ONE

BACKGROUND AND SUMMARY

Background

In May 1986, the Montana Department of Health & Environmental Sciences (DHES), Solid & Hazardous Waste Bureau selected the firms of Environmental Resources Management, Inc. (ERM) of West Chester, Pennsylvania, and Damschen & Associates of Helena, Montana, to conduct a study of hazardous waste management options for Montana. The primary emphasis of the project included the identification of current waste management conditions and the evaluation of potential storage, transfer, treatment and disposal alternatives for hazardous wastes and used oils generated in Montana.

During the initial stages of the project, the EPA finalized its guidelines concerning the listing of oil as a hazardous waste; these final guidelines reversed the draft guidelines which had stated that used oil would be listed as a hazardous waste. Because used oils are now not listed hazardous wastes unless they have been mixed with hazardous wastes and demonstrate the associated characteristics, the DHES decided to prepare a separate report evaluating the management of used oil in Montana.

During the course of the inventory and analysis phases of this project, it was also deemed appropriate to conduct a special analysis on used solvents generated in the state. This is due primarily to the fact that solvents can be more easily and economically recycled than most other hazardous wastes generated in the state and have potential value as fuel sources as does waste oil. Furthermore, our analysis indicated that a major portion of the hazardous wastes surveyed during the study were solvents. Finally, it has been the experience of the consultant in other states that mismanagement of solvents has resulted in the contamination of ground water at a great number of sites. Based on these reasons, the consultant has also addressed the evaluations concerning the recycling of solvents in this separate report.

The information contained herein generally includes the following:

1. The estimated quantities of solvents and used oils generated in the state,

2. The existing status of the regulations concerning used oils and solvents,

3. The management methods currently being employed in the state for solvents and used oils,

4. The evaluation of various alternatives for the reuse and recovery of used oils and the recovery and recycling of used solvents, and

5. The consultant's recommendations concerning the recovery of used oils and solvents in the State of Montana.

The reader of this report is encouraged to obtain and refer to the Hazardous Waste Feasibility Study Report that is also being prepared under this project. This cross-reference should provide additional information concerning management of hazardous waste generated in the state.

Summary of Findings

Quantities

To identify the quantities of used oils, solvents, and other hazardous wastes generated in Montana, a survey of potential generators of these wastes was conducted. Based on survey results, the surveyed quantities of wastes were extrapolated to estimate expected statewide totals. The extrapolated waste estimates identified that approximately 2.2 million gallons of used oils, 147,000 gallons of used solvents, and 132,000 gallons of other hazardous material are generated in Montana annually.

Analysis of Used Oils

Up until three years ago numerous outlets existed for used oils. Consequently "marketers" traveled the state and paid used oil generators up to $.30 per gallon for their used oil. However, the decline of crude oil prices coupled with the curtailing of use of used oils for dust suppression on roads has caused most marketers to go out of business. Those marketers remaining presently are charging up to $.25 per gallons to collect and dispose of used oils. Consequently many generators are stockpiling their used oils awaiting an economically feasible solution to this problem.

Based on the analysis conducted in this study, the consultant has made the following recommendations:

1) Where feasible, individuals should purchase small heating units that are designed specifically to burn used oils. These individuals should, however, be fully aware of the rules and regulations that govern the use of these units, and

2) Since it is not feasible due to energy requirements, space considerations, etc., for the majority of the used oil generators in the state to utilize individual heating units, it is recommended that a detailed study be conducted to finalize the economic feasibility of implementing a centralized processing facility. Under this program the used oils could be transported to a central facility for processing; the resultant product could be used as a fuel source in a nearby existing facility. Existing cement plants, power plants, and large steam generation facilities in the state have been identified as potential users of the processed oils.

The net costs for both utilization of individual heating units and implementation of a central processing facility appear to be substantially less expensive than current disposal practices. The net costs are estimated to vary from $0.00 per gallon to $0.19 per gallon. This compares to existing disposal costs of approximately $0.20 to $0.25 per gallon.

Analysis of Used Solvents

Under existing policies and regulations, SQG-generated solvents cannot be disposed of in landfills unless the solvents are absorbed or solidified. Most landfills in the state will not accept solvents even if they have been solidified. The disposal option utilized by several of the larger solvent generators is to contract with a firm(s) to transport and dispose of the waste at licensed hazardous waste facilities located out of state. Disposal at these facilities varies from $100 to $300 or more per drum depending upon the type and volume of solvent.

For this study three basic alternatives for recycling solvents were identified as being potentially feasible. These options included 1.) a central processing facility with demand for fuel, whereby solvents generated in the state could be brought to a processing center for ultimate use as fuel, 2) a central reclaiming facility whereby the solvents generated in the state could be brought to a distillation facility for recycling for

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reuse, and 3) a mobile program where one or more mobile distillation units would travel to the individual generator's location and process the solvent for reuse. The net costs for these options are in the range of $35 to $40 per drum. These estimated costs are considerably less expensive than current costs for disposal at out-of-state licensed facilities.

Because of the high costs of disposal coupled with the economic attractiveness of recovering solvents for reuse, private firms have entered the marketplace to provide recovery services for solvents. Safety Kleen, a national firm that provides a reclaiming service for solvents, is currently serving many generators in western Montana and has indicated the intent to expand to many areas of the state in the near future. A second firm, Special Resources Management, Inc., based in Montana has indicated the intent to provide a mobile distillation unit(s) similar in theory to the option discussed in this study. Additional firms have also indicated their intent to serve the state in one capacity or another.

Based on the analysis conducted for this study it is recommended that private enterprise take the lead at this time in providing reclaiming services to the solvent generators in the state. Correspondingly, the Dept. of Health personnel should monitor the effectiveness of these companies to make sure that the solvents generated in the state are being disposed of or recycled properly and legally. If in time it appears that private enterprise may need assistance to handle the solvent disposal situation, the state of Montana should strongly consider implementing a state-wide reclaiming program. The program could include the use of mobile units to handle the smaller generators and a central distillation facility to handle the larger generators.

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SECTION 2

WASTE QUANTITIES

SECTION TWO

WASTE QUANTITIES

Methodology

Waste generation by the following three generator categories was analyzed in the Hazardous Waste Management Options Study:

Large Quantity Generators (LQGs)
Small Quantity Generators (SQGs)
Very Small Quantity Generators (VSQGs)

LQGs are those establishments which generate 1000 or more kilograms (2200 lbs) of hazardous waste per month. The National Small Quantity Hazardous Waste Generator Survey[1] distinguishes between SQGs and VSQGs as follows: SQGs are establishments that generate less than 1000, but 100 or more, kilograms of hazardous waste per month. These generators have been regulated as of 22 September 1986. VSQGs are those establishments that generate less than 100 kg (220 lbs) per month of hazardous waste, and as of this date are exempted from most hazardous waste regulations. The same distinction is made in this study. Household hazardous waste is not included in the estimate of waste generation by VSQGs. Its pattern of generation is not established at this time, and reliable estimates are not available.

Wastes generated by LQGs, specifically solvents and oils, were excluded from further analysis in the Oil/Solvent Study. It was assumed that the economics of recycling and/or disposal are different for this group of generators and the quantities of waste they generate have already initiated recycling activities if such are economically feasible. Their waste is therefore assumed to be "unavailable" for the management initiatives discussed in this study.

Survey of Generators

To identify the quantity of used oils, solvents and other hazardous wastes generated by Small Quantity Generators in the state, a survey was conducted during the initial stages of the project. Information solicited by the survey included currently generated quantities of hazardous waste as well as waste oil, and current management methods used.

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[1]Abt Associates. National Small Quantity Hazardous Waste Generators Survey. February 1985.

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The survey included both SQGs and VSQGs, since no distinction could be made when designing the survey. The objective was to survey all establishments in the state belonging to the 125 Standard Industrial Classification (SIC) codes identified in the National SQG survey as potentially containing significant numbers of small generators. The SIC codes and the 23 broader industrial categories to which they have been assigned by EPA (on the basis of similar market sector and waste types) are provided in Appendix A. In addition, an effort was made to include all city, county, state and federal government agencies in the survey. These government agencies were assigned to a new category created by the consultant for completeness.

A total of 8823 survey forms were sent to potential generators, of which 2039 surveys were completed and returned for an overall response rate of 23 percent. In order to estimate state-wide hazardous waste and waste oil totals, a method for extrapolating the survey response was developed. This extrapolation method involved two steps. First, statewide estimates of the total number of establishments in each industry group were determined using Department of Labor figures and number of returned surveys. Second, a "scale-up" factor was computed to extrapolate the surveyed quantities to statewide estimates.

Studies from other states have shown that extrapolation based on potential predictors of waste generation, such as the number of employees or value added shipments, are of limited use because of a lack of strong correlation or lack of valid data. Therefore, a simple proportional scale-up factor was developed for each industrial category. The scale-up factor for each industrial group was derived by dividing the estimated total number of establishments in the entire state by the number of survey responses. The total quantity of each waste type reported in an industrial group was then multiplied by the scale-up factor to estimate state-wide total waste generation.

Quantities

The resulting extrapolated estimates of solvent and used oil generation by small and very small quantity generators by industry group are presented in Table 2-1. A summary of the extrapolated quantities of used oils, solvents and other hazardous wastes for the small and very small generators is graphically depicted on Figure 2-1. Extrapolated estimates of solvents and used oils generated by small and very small quantity generators are given by planning region in Table 2-2 and Figure 2-2 (regional estimates and statewide totals in Figure 2-2 are

TABLE 2-1

EXTRAPOLATED WASTE ESTIMATES (IN GALLONS) BY INDUSTRY GROUP

INDUSTRY GROUP	TOTAL WASTE	OILS	SOLVENTS	HAZARDOUS WASTE	HAZARDOUS WASTE MINUS SOLVENTS	TOTAL WASTE	OILS	SOLVENTS	HAZARDOUS WASTE	HAZARDOUS WASTE MINUS SOLVENTS
CHEM. MFG.				0	0	0	0	0	0	0
CL. COS. MFG.				0	0	26	8	0	18	18
CONSTRUCTION	87406	65760	4384	21646	17262	77076	66801	7652	10275	2623
ED. VOC. SHOPS	1251		1251	1251	0	14845	12265	1796	2580	784
EQUIP. REPAIR	5581	1775	895	3806	2911	16444	13352	3060	3092	32
FORMULATORS				0	0	0	0	0	0	0
FURN. MFG.				0	0	961	874	84	84	0
GOVERNMENT	20327	12075	4377	8252	3875	26979	22538	2505	4441	1936
LABS	5362	879	879	4483	3604	4445	1058	1486	3387	1901
LAUNDRIES	4602		4602	4602	0	10196	89	10107	10107	0
METAL MFG.	3143	65	810	3078	2268	4194	965	1990	3229	1239
METAL USERS				0	0	0	0	0	0	0
MTR. FRT. TERM.				0	0	40	40	0	0	0
OTHER MFG.	1639		1629	1639	10	0	0	0	0	0
OTHER SERVICES	4380			4380	4380	1762	66	53	1696	1643
PAPER INDUSTRY				0	0	0	0	0	0	0
PEST. SERVICES	13286	2322	64	10964	10900	1981	321	21	1660	1639
PEST. USERS	1915			1915	1915	613	421	34	192	158
PHOTOGRAPHY	5624			5624	5624	1585	0	9	1585	1576
PRINTING	13222	311	4944	12911	7967	4806	209	339	4597	4258
TEXTILE MFG.				0	0	0	0	0	0	0
VEHICLE MAIN.	347318	264759	47438	82559	35121	1795949	1734909	46521	61040	14519
WH. RET. SALES	1365			1365	1365	18458	17379	164	1079	915
WOOD PRESERVERS				0	0	1095	0	0	1095	1095
TOTAL	516421	347946	71273	168475	97202	1981455	1871295	75824	110160	34336

*Explanation of Categories:

Total Extrapolated Waste - Total volume of wastes including used oils, solvents, and other hazardous wastes

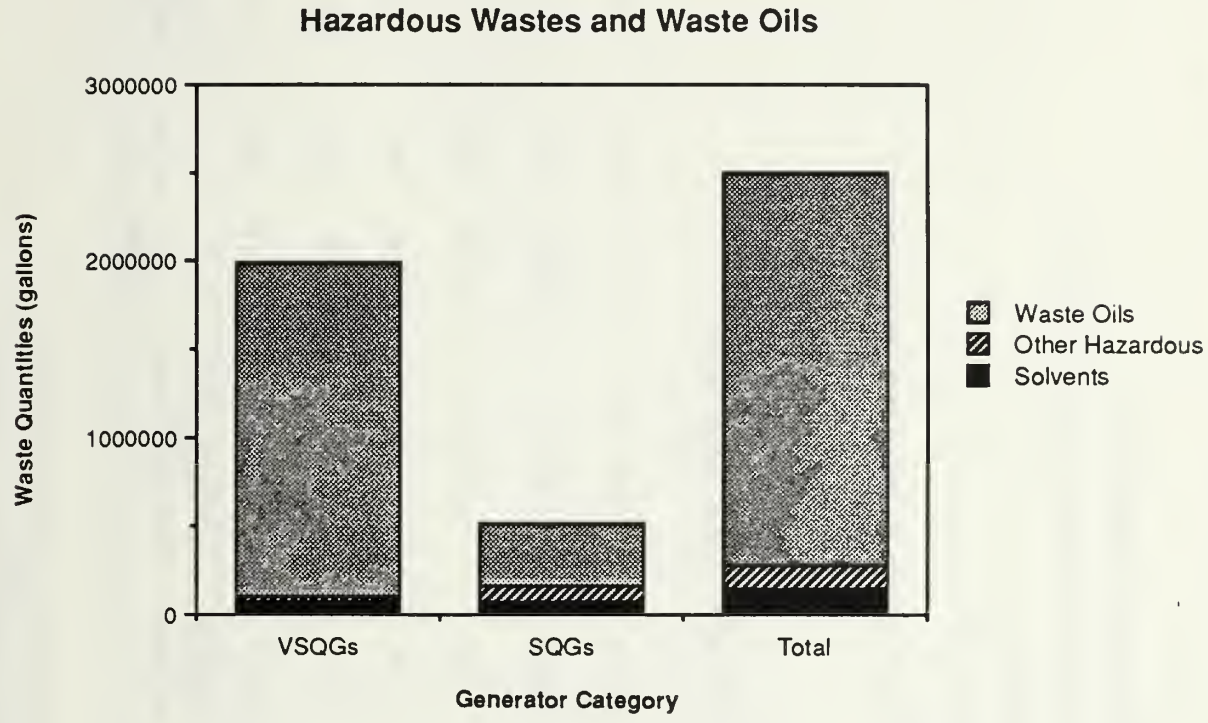
Oils - Volume of waste oils only

Solvents - Volume of solvents only

Hazardous Waste - Volume of all hazardous wastes (includes solvents but not used oils)

Hazardous Waste Minus Solvents - Volume of hazardous wastes excluding solvents

Figure 2-1
Extrapolated Waste Quantities by Generator Category (Gallons/Yr.)



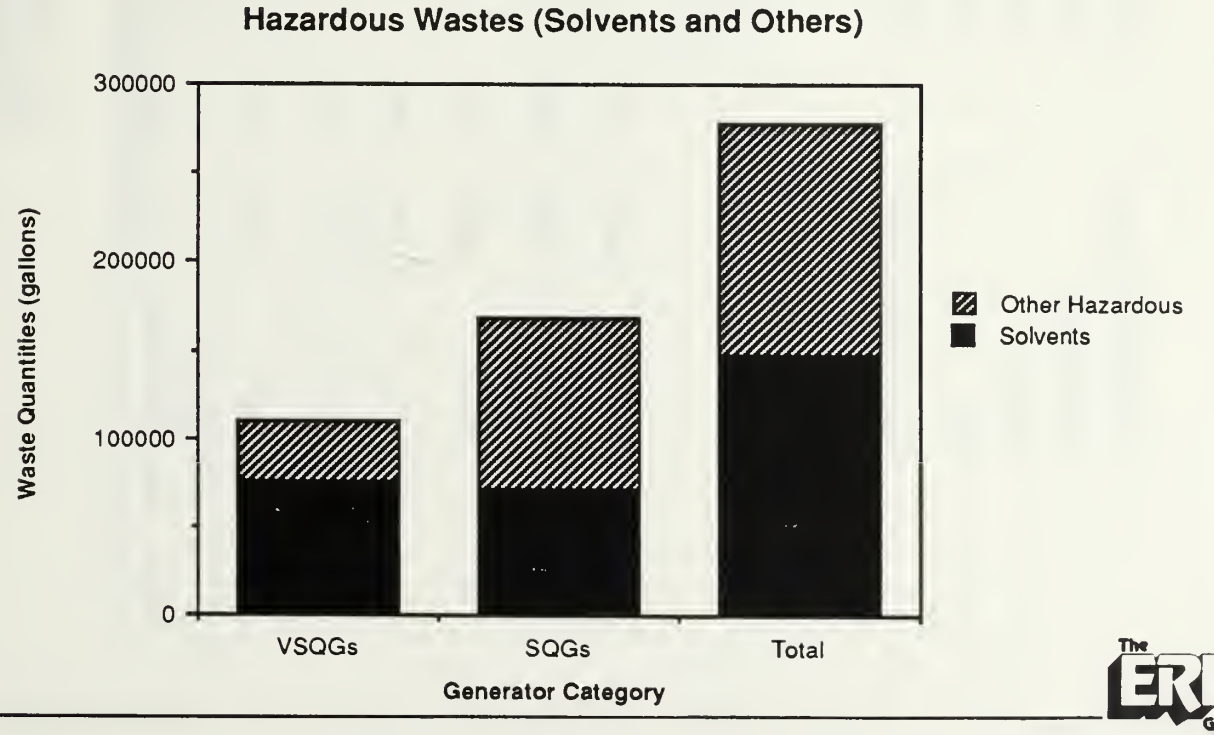


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Table 2-2
Extrapolated Regional Totals (in Gallons) by Waste Type

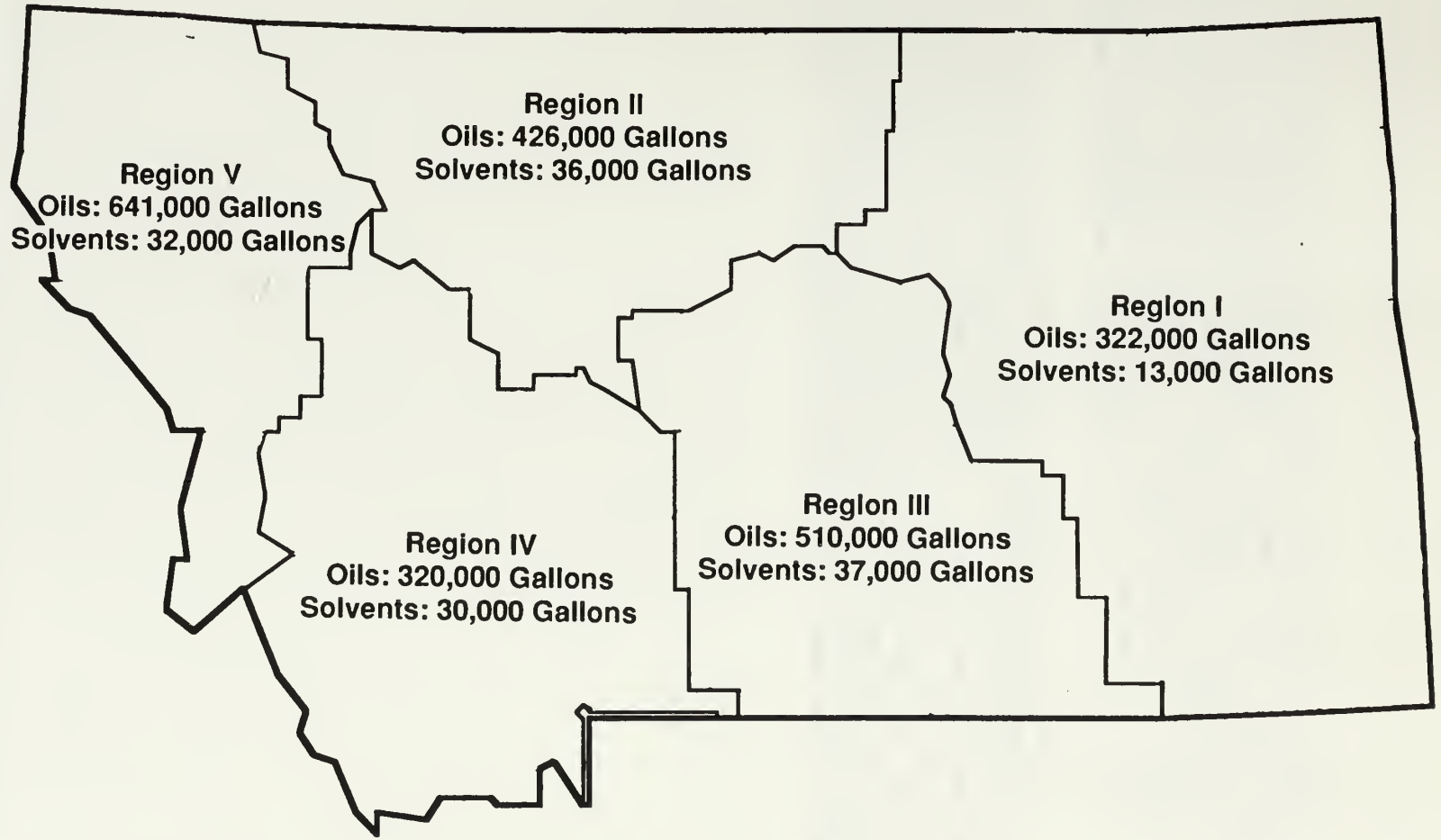
REGION	TOTAL EXTRAPOLATED WASTE (Haz. Waste + Oils)	Small Quantity Generators OILS	SOLVENTS	HAZARDOUS WASTE (Total - Oils)	HAZ. WASTE MINUS SOLVENTS	TOTAL EXTRAPOLATED WASTE (Haz. Waste + Oils)	Very Small Quantity Generators OILS	SOLVENTS	HAZARDOUS WASTE (Total - Oils)	HAZ. WASTE MINUS SOLVENTS
I	77383	60074	2076	17309	15233	276707	261754	10616	14953	4339
II	56432	24934	17544	31498	13954	427114	401196	18241	25918	7677
III	136261	96199	20302	40062	19760	437188	413958	16454	23230	6776
IV	139013	96682	19094	42331	23237	241450	223440	10791	18010	7219
V	107331	70057	12256	37274	25018	598999	570942	19721	28057	8336
TOTALS:	516420	347946	71272	168474	97202	1981458	1871290	75823	110168	34347

Total Oils (SQG+VSQG): Approx. 2219000 gallons
Total Solvents (SQG+VSQG): Approx. 147000 gallons

* Explanation of Categories:

Total Extrapolated Waste	-	Total volume of wastes including used oils, solvents, and other hazardous wastes
Oils	-	Volume of waste oils only
Solvents	-	Volume of solvents only
Hazardous Waste	-	Volume of all hazardous wastes (includes solvents but no used oils)
Haz. Waste Minus Solvents	-	Volume of hazardous wastes excluding solvents

Figure 2-2
Extrapolated Waste Estimates (in Gallons) by Planning Region



Totals:
Oils: 2,219,000 Gallons
Solvents: 148,000 Gallons

rounded independently to the nearest thousand gallons). VSQs generated 84% of the surveyed amount of waste oil, and 52% of the surveyed amount of waste solvents. This is of particular note when considering the fact that this size of generator is not fully regulated, suggesting that the potential for mismanagement of wastes among generators in this group is high. The distribution of waste oil and solvent generation appears to be fairly homogeneous across the state.

It should again be noted that household hazardous waste generation is not included in these waste generation estimates, therefore neglecting a large portion of the do-it-yourselfers who dispose of waste oil in some manner. Nationwide estimates[2] predict that approximately 350 million gallons per year of waste oil is generated by this group; no estimate on the amount collected or disposed of is available. The amount of this waste oil potentially available for recycling/reuse will depend in large part upon the collection services and associated incentives available.

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[2]Dennis Brinkman, National Institute for Petroleum and Energy Research. Interview in Resource Recycling, March/April 1984.

SECTION 3

ANALYSIS OF THE MANAGEMENT OF USED OILS

SECTION THREE

ANALYSIS OF THE MANAGEMENT OF USED OILS

Introduction

The purpose of this chapter is to evaluate the management of used oils in Montana. The sections within this chapter discuss the following:

- Regulatory status
- Current management methods
- Discussion and selection of alternatives,
- Evaluation of alternatives.

Regulatory Status

Proposed Regulations

The Hazardous and Solid Waste Amendments of 1984 required EPA to determine by 8 November 1988 whether used oil should be listed as a hazardous waste. On 29 November 1985, the agency issued two proposed rules; one proposed the listing of all used oils as hazardous waste, the other proposed standards for generators and transporters of recycled oil, and owners and operators of used oil recycling facilities. The latter proposal included tracking requirements when used oil is shipped off-site for recycling, and facility management requirements when used oil is stored prior to recycling. It also proposed that recycled oil used as fuel would be subject to certain regulations, uses of recycled oil that constitute disposal would be regulated as land disposal and the outright prohibition of road oiling. On 19 November 1986, EPA issued a decision not to adopt either rule due to the adverse impacts both might have on the used oil recycling industry.

EPA received a great number of comments on both proposed rules, the most controversial being the proposed listing of used oil as a hazardous waste. A large portion of the comments suggested that listing would disrupt established collection and recycling networks, leading ultimately to improper used oil disposal. The EPA itself estimated that the listing of recycled oil as

hazardous waste could cause an additional 61-128 million gallons per year of used oil to be disposed of in uncontrolled ways. Other comments stated that strict regulation of used oil burners could potentially cause them to switch to readily available virgin fuel substitutes, compounding the existing unfavorable market for recycled oil. The agency therefore dropped the proposed rule, concluding that the listing "could pose a net detriment to the environment." However residues, wastewater streams, and sludges associated with the recycling of used oil are being evaluated and may be listed as hazardous.

The proposal for management standards was dropped due to the EPA's perceived inadequacy of the proposed regulations to insure proper used oil recycling, as well as the perception that some aspects of the proposal may be so stringent as to cause similar impacts as the recycled oil listing.

The issue of listing used oil bound for disposal as a hazardous waste is still under consideration; however, EPA states that "any used oil listing, even if limited to used oil being disposed of, could be associated with some of the same impacts as a recycled oil listing." The agency is therefore considering two alternatives: to use a Toxic Substances Control Act (TSCA) listing in lieu of a RCRA one, or to use the considered RCRA listing. The decision between the two alternatives was scheduled to be made in early 1987 but as of this printing has not been announced; schedules for formulating regulations under each alternative have already been set, and both call for final regulations in mid-1989.

Current Regulations

The existing set of regulations dealing with used oil were issued on 29 November 1985, and deal with the burning of waste fuel and used oil fuel in boilers and industrial furnaces. The rule served two purposes: to classify types of combustible materials and to classify types of combustion equipment. Combustible materials fall into two groups - used oils and hazardous waste fuels. Used oil that contains more than 1000 ppm total halogens is presumed to be mixed with hazardous waste, and thus a hazardous waste fuel, unless the presumption is rebutted; other criteria are also listed. Halogens include any of a group of five chemically related elements that have been absorbed by the oil including fluorine, chlorine, bromine, iodine or astatine. Hazardous waste fuels may presently only be incinerated in equipment meeting RCRA hazardous waste incineration standards. (Proposed rules published May 6, 1987, would change this rule by

establishing technical controls for burners.) Used oils that are not considered hazardous waste fuels are further separated into two subclasses; those that meet certain used oil specifications[1] and are termed simply "used oils", and those that do not meet one or more of the specifications and are termed "off-spec used oils". Used oil (meeting the specifications) can be burned in boilers (non-industrial or otherwise) or in industrial furnaces. Off specification used oil, however, may only be burned for energy recovery in the following devices:

- specified industrial furnaces, and

- specified boilers, including:

    - o industiral boilers
    - o utility boilers, and
    - o used oil-fired space heaters, provided that

        1. The heater burns only used oil that the owner or operator generates or used oil received from do-it-yourself oil changers who generate used oil as household waste;

        2. The heater is designed to have a maximum capacity of not more than 0.5 million BTU per hour, and

        3. The combustion gases from the heater are vented to the ambient air.

(The EPA will in the future be proposing management standards for owners and operators of boilers and industrial furnaces burning off-spec used oil fuels.) Of the many promulgated rules in this issuance, the Used Oil Fuel Lead Specification initiated the most havoc within the used oil recycling industry. Specifically, an absolute lead limit of 100 ppm was promulgated as one of several "on specification" used oil fuel parameters. This lead specification was derived via numerous channels, i.e., the

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[1]EPA used oil specifications are:
- flash point 100°F or above
- less than 5 ppm arsenic
- less than 2 ppm cadmium
- less than 10 ppm chromium
- less than 100 ppm lead
- less than 4000 ppm total halogens

National Ambient Air Quality Standard for Lead, prior lead levels found in used crankcase oil and finally, the phasedown of lead in leaded gasoline promulgated by the EPA beginning in the Spring of 1985. It is widely known that the maximum lead content of a used crankcase oil derived from a diesel or unleaded fueled engine is about 10 ppm; therefore, any additional lead found in a used crankcase oil is directly attributable to the use of leaded gasoline.

The EPA's analysis of the consequence of a 100 ppm lead limit assumed an absolute lead phasedown in leaded gasoline as follows:

January, 1985:	1.1 g of lead per gal. of gasoline
July, 1985:	.5 g of lead per gal. of gasoline
January, 1986:	.1 g of lead per gal. of gasoline

However, the EPA's lead in leaded gasoline rules (promulgated in the early Spring of 1985) allowed for the establishment of a "lead credits" bank or market. In effect, a producer or blender of leaded gasoline could and can until January 1, 1988, buy lead credits, thus legally bringing themselves into conformity with the lead specifications detailed above even though the actual lead levels contained in their gasoline is substantially above the .1 g/gal. limit. The net effect of this "lead credits" market, by EPA's own analysis, was that at the end of the 1st quarter of 1986, the lead levels in leaded gasoline on average across the U.S. was not .1 g/gal., but .3 g/gal.

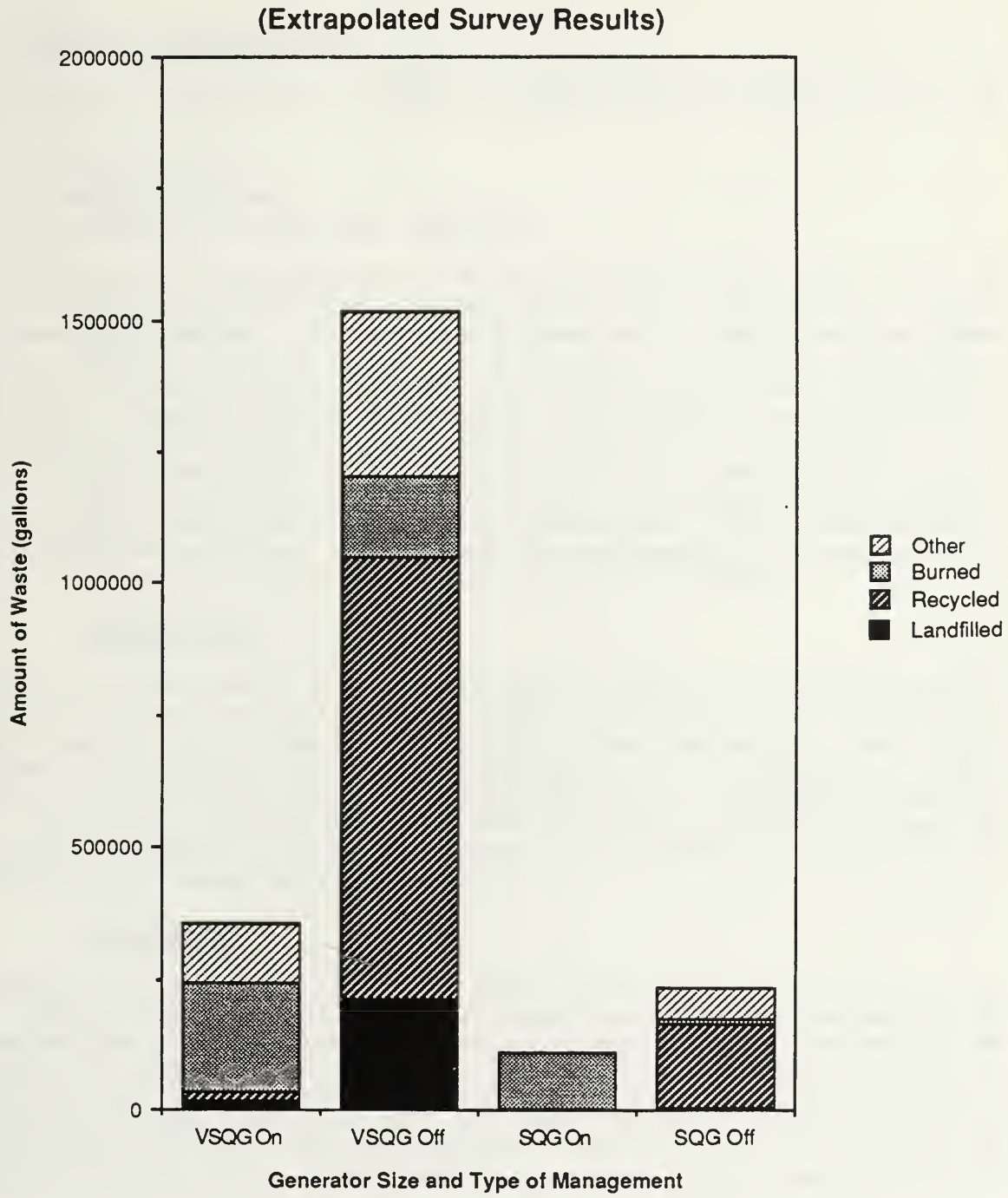
The oil recycling industry is seeing on average 200 ppm lead in its feedstocks today, or twice the allowable limit. Two options are available: blending of reprocessed fuels with virgin fuels, or notification to customers that the fuel is off-spec and subject to additional requirements for burning.

Current Management Methods

Results of Survey

Extrapolated results of the survey pertaining to current management methods of oil wastes, for both SQGs and VSQGs, are summarized in Figure 3-1. Further breakdown of the data is presented in Appendix B. The majority of SQG waste (48%) is sent off-site for recycling, while 32% is burned on-site for fuel value. For VSQGs most of the oil is also sent off-site for recycling (45%) or burned for fuel value on-site (11%) or off-site (8%). A substantial amount is also disposed of off-site in landfills (11%) or in various on-site land disposal options

Figure 3-1
Used Oil Management Practices



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(1 %). This indicates a high potential for mismanagement of these wastes.

Results of Interviews

Three major categories of final disposition of used oils can be established:

1) landfilling,
2) recycling, and
3) burning in individual boilers.

The consultant interviewed various individuals that may be involved or responsible for the management of used oils in each of these categories. Individuals that were contacted included various generators of used oils such as service stations, trucking firms, etc.; individuals and companies involved in collecting, reusing and/or disposing of used oils as a business (commonly referred to as "marketers"); private, municipal and county employees currently responsible for the operation of sanitary landfills throughout the state; and users and recyclers of used oils. Based on these interviews, the following general conclusions were drawn concerning the management of used oils in each of the three categories of disposition in Montana.

Landfilling

Through interviews with municipal and county government officials, it was determined that very few landfills in the state accept used oils. The few landfills that do accept used oils require that the oil be solidified prior to disposal. This solidification requirement is consistent with the State's policy. Most officials indicated that the risk of pollution due to disposing of used oils was too great and therefore have taken the "no disposal of used oils" position.

Recycling

According to the regulations, those individuals who "buy and sell" used oil for a profit or business venture are referred to as marketers. The consultant interviewed several marketers to identify the existing condition of these operations. Generally speaking, it was determined that due to the low virgin oil prices, the market for used oil has been drastically reduced in the last 18 months. Correspondingly, where there were literally dozens of individuals or businesses active in the marketing of

used oils two to three years ago, there are now approximately only a few still in business in the state.

According to the marketers and the major used oil generators such as service stations, contractors, trucking firms, etc., the outlets for used oil have significantly changed in the last 18 months. The following statements summarize each of the existing primary markets in Montana.

Dust Control. A major outlet for used oils in the past has been to spread used oil on gravel or unimproved roads for dust control. Regulations concerning this procedure are summarized as follows:

- Federal EPA regulations do not currently prohibit the use of used oil for road dust suppression; however, these regulations do prohibit the use of hazardous wastes for dust suppression. If hazardous wastes have been mixed with the used oil, the entire mixture may be classified as a hazardous waste.

- State Environmental Regulations prohibit the contamination of surface and ground waters. Used oil cannot be applied for dust suppression in areas which might threaten these water sources.

- Local fire codes may also prohibit the application of used oil on streets and roadways. The local fire department or fire authority should be contacted prior to the application of any oil for dust suppression.

According to the interviews that were conducted for this project, the DHES and local Health Departments throughout the state are taking a more active role in evaluating the contamination potential of surface and ground waters. At this time, it appears that fewer instances of used oils are being approved for dust control. Thus, the market outlet for used oils for this purpose is very limited in comparison to a few years ago when this practice was a leading method of disposal.

Hot Mix Plant Fuels. Until about three years ago, many of the paving contractors in Montana and bordering states utilized used oils as a fuel in hot mix plants. At that time the State of Oregon conducted numerous tests to determine if the plants had any detrimental effects on the pavement. Those studies indicated that the used oils were not achieving total burn up during the drying operation and ultimately contaminating the bituminous mix. The evaluation determined that this contamination caused

pavements to become soft, contributing to rutting and premature failure.

Based on these studies, the Montana Department of Highways banned the use of used oils for use as fuels in hot mix plants in 1985. More recently the Department has changed its policy concerning this subject. The current policy allows used oils to be used for fuels if the oils meet the viscosity, percentage water and percentage solids requirements of ASTM D396 Grade 2 fuel oils. To achieve these requirements, it most likely will be necessary to process and filter any used oils prior to use in hot plants. The degree of processing will be dependent on the original use and contamination level of the oils.

Power Plants. Another outlet utilized by marketers for used oils is large electrical generating power plants; for the most part these power plants were located out of state. The power plants purchase the used oils as supplemental fuels. Marketers contacted indicted that some power plants spread used oil on coal in storage prior to its use, whereas other plants would inject the used oils directly into the boilers.

According to marketers that were contacted, this market situation is not as attractive as it was approximately three years ago when the price of fuels was considerably higher. The lower price of crude oil has substantially reduced the value of used oil as a fuel. Marketers have indicated, however, that power plants are still a market for used oil but on a significantly less economically attractive basis.

Re-refining Plants. In the past, two privately owned re-refining plants were in operation in the Billings area. These plants have been closed in recent years. Four primary reasons for the closures include: (1) increased regulations, (2) poor market conditions for the products, (3) poor economic feasibility when compared to larger, more modern plants, and (4) less costly disposal options available. Through the discussion and interviews conducted for this project, it does not appear that these re-refining operations will re-open. There are some oils, however, that are being shipped out of state for re-refining on a limited basis.

Summary of Recycling Situation. In general, market conditions for used oils are reflected in the economics of collection. Up until two years ago, marketers were purchasing used oil for $.20 to $.35 per gallon from generators;currently marketers are charging up to $.25 per gallon to pick up the used oils. The

number of marketers in the state has been substantially reduced due to lower crude oil prices coupled with road oiling restrictions. As a result of these overall poor market conditions, many generators are stockpiling used oils awaiting a market change or the provision of more advantageous options.

Individual Heating Units

Through interviews with several used oil generators it has become apparent that many generators have or are planning to purchase heating units designed to burn fuel oil, used oils or combinations thereof. There are several manufacturers of furnaces designed to burn these oils that meet the various State and Federal regulations. These units can be purchased and installed for approximately $4500 (150,000 BTU/hr) to $6000, depending on the size desired.

Because landfills for the most part will not accept used oils coupled with the fact that the "marketer" outlets have significantly deteriorated over the past two years, the use of heating units is expected to increase if other disposal options are not developed.

Selection of Alternatives for Further Analysis

Overview

Landfilling of used oils is not considered a viable disposal option, and will not be considered further. Some recycling alternatives, however, represent viable options.

Recyclers of waste oil can be broken down into two main categories: 1) those who recycle the oil for fuel, and 2) those who re-refine the oil for reuse as lubricants. The two categories differ mainly in the end use of the products, not necessarily in the processes used. They will be referred to further in this document as recyclers and re-refiners, respectively, for ease of discussion. It should be noted, however, that both groups qualify as "recyclers" of used oil.

Recycling generally involves an emulsion breaking process, centrifugation, a high heat or topping tower process to drive off kerosene and other light ends, and a final filter process. The emulsion breaking and centrifugation steps may be eliminated, using a high heat process to get rid of the water in the oil. Recycled oil can be substituted or supplemented with No. 2, 4, 5, or 6 grade virgin fuel oil and used as a fuel source.

Waste oil re-refining generally employs one of two methods - the outdated acid/clay method or the modern vacuum distillation method. The distillation method involves the following processes developed by the U.S. Department of Energy's Bartlesville Energy Research Center:

- Waste oil feedstock inspection and storage
- Dehydration and fuel stripping
- Metal removal
- Vacuum distillation
- Hydrotreating

New technologies such as thin-film evaporation and supercritical extraction may eventually become important.

Waste oil re-refining will produce oils of a quality virtually equal to lubricating oils refined form virgin feedstock. Some lower grade oil suitable for fuels is also recoverable. In fact over fifty percent of the oil processed by a re-refinery may be of this class.

The relative amounts of waste oil that are recycled for use as fuel vs. re-refined has been a controversial topic among oil recyclers for years. Until EPA published its final rule on the regulation of waste oils on 29 November 1985, those who recycled waste oil for use as fuel far outnumbered re-refiners. There has been a sharp reduction in the number of re-refining companies, numbering over 150 some 30 years ago to only about six in North America today. By contrast, there are at least 250 companies involved in recycling mainly for use as a fuel in the United States alone, belonging to such associations as the National Oil Recyclers Association. A total inventory is not available.

Economics of Recycling of Lubricating Oils and Fuels. Approximately 4 years ago, the 6 percent U.S. excise tax on virgin oil was removed. Removal of the tax had a direct effect on re-refiners, eliminating the tax advantage to their process. To effectively compete with virgin oil prices, re-refiners lowered prices of re-refined oil, affecting not only their profit margin, but ultimately the price paid to collectors of used oil. A similar situation occurred with recyclers. However, recycled used oil for fuel use remains 10-20 percent less expensive than refined crude oil for fuel use. Even though a Franklin

Associates' study[2] showed re-refined lubricating oil products worth roughly twice as much as the product's value as a fuel substitute, processing costs make it difficult for re-refiners to compete with marketers wanting used oil for fuel.[3]

Until 29 November 1985, waste oil regulations were such that no long term costs were associated with the burning of used oil for fuel. This, in conjunction with increases in the price of fuel oils, led to a dramatic increase in the burning of used oils. With used oils available at such a relatively low price in comparison with virgin oil, and the quantities of fuel needed for industrial operations, large industrial plants use waste oil as fuel in order to save hundreds of thousands of dollars in operation and energy costs.

Regulatory Effects. The effect of the 29 November 1985 controls discussed previously on all recyclers is difficult to predict, and the outcome has still not been indicated due to stockpiling of oil by recyclers. Estimates of the percentage of oil previously recycled and now considered "off-spec" ranges from 80-100%. Most of this oil is considered off-spec due to high lead levels, or the presence of chlorinated extreme pressure additives in industrial lubricants. Although January 1986 regulations have decreased allowable lead levels in gasoline by 90%, lower lead levels in waste oil will not be realized instantly, due to leaded bottoms of oil storage tanks and a number of other factors. The economic outcome of this uncertainty has been a drastic decrease in the amount of money paid by collectors for used oil. On the average, prices paid by collectors have changed from $.20/gallon paid to generators to $.25/gallon charged to generators for pick-up. Illegal disposal is expected to increase markedly; the regulatory burden of the controls is expected to discourage recyclers from handling used oil, and numerous operations such as service stations will stop collecting it.

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[2]Franklin Associates, Ltd., Composition of Used Oil.

[3]Oil Recycling's Burning Issues. Resource Recycling. Nov/Dec 1983.

Centralized vs. Decentralized System. Due to the large capital investment and high operating costs associated with a re-refinery, the capacity required to make a re-refinery economically viable is much larger than the capacity required to make a recycling operation economically viable; it is estimated that the optimum size for a present day re-refinery is approximately 10 million gallons per year[4]. Their collection area, therefore, has to be be much larger, and the establishment of a reliable feedstock supply is probably the most critical consideration. Transportation costs for collection can be a major cost of recycling; current costs on a national scale average approximately $0.05 per gallon per 100 miles.[5]

Capacity of Re-refiners vs. Recyclers. Recent figures for oil indicate that approximately 2.5 billion gallons of lubricants are sold in the U.S. each year. Approximately half is lost or consumed during use, and only about 800-900 million gallons per year of the remaining oil will ever be practical to recover. Of the 600 million gallons per year estimated to be collected, over 400 million are burned, 100 million gallons are re-refined, 50 million is used on the roads, and the remaining 50 million is disposed of.

Restrictions on burning used oil could shift a tremendous amount of oil to re-refining. Re-refiners state that they could increase their current capacity by approximately 40% per year; however, this figure is considered unattainable by some recyclers. A sudden shift from burning to re-refining would certainly strain existing capacity. In contrast, asphalt plants alone burn approximately 90 million gallons per year.

It seems apparent that decreased virgin oil prices, the potential listing and regulation of used oil as a hazardous waste, and the regulated lead level caused a depression of activity in conventional transportation and disposal markets for used oils, with subsequent stockpiling of oil by both generators and recyclers. It is not known at this time whether existing transportation and marketing structures can be sufficiently reactivated by new or existing markets. However, the potential use of waste oils as fuel sources cannot be ignored due to the

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[4]Waste Hydrocarbon Recycling; CEP March 1986.

[5]John Nolan, President, National Oil Recycler's Association, February 21, 1986

estimated magnitude of the potential market. Recycling of used oil for use as fuel is therefore selected for further evaluation.

Burning of oil in individual boilers will continue to be a viable option in light of the existing regulations; it will therefore be assumed to increase in practice to the fullest extent possible, and is also considered further.

Summary

Previous disposal alternatives for used oils, such as disposal in landfills or on gravel roads for dust control, are no longer viable options. Furthermore, purification of waste oils to produce products that are equal in quality and value to the original is technically possible but for the most part not cost effective under current market conditions in Montana. Based on this, the most practical method to manage used oils is to utilize the oils as a fuel source.

It was recognized that two methods exist by which this can be done. One is for various individual generators to install small heating units; the second is the implementation of a regional or statewide collection, processing, and utilization plan for use of recycled oil as fuel. It should be noted that some processing of used oils is desirable and necessary for end use as a marketable fuel; BTU value, water content, metal content, chloride content, and solids content requirements will vary for fuels destined for different uses. Both alternatives are evaluated for their applicability in Montana as follows.

Central Used Oil Processing Facility - General Concepts

A central facility is desirable to maintain quality control of oils reclaimed into fuels and to control outlets for such fuels. Various aspects of such a facility are described as follows.

Description of Operation

Waste oil processing consists primarily of solids filtration and water and light ends separation. Suspended solids would be removed in a series of filters of decreasing mesh/pore size. Following laboratory testing for solids, water, and chlorine/halogen content, the waste oil would be filtered further and then heated via a heat exchanger to approximately 120°F. The heated oil would then be routed to a flash tank, from which light vapors would be collected. The remainder of the waste oil

mixture would be passed through a second heat exchanger to raise the waste oil to approximately 230°F. Processing through a second flash tank would remove water vapor. Finally, the waste oil would be heated to approximately 250°F and passed through a final solids separation step. Following additional laboratory testing for used oil fuel specifications, the recovered oil would be blended with previously-processed batches in storage to homogenize the finished product.

Residuals would consist of a condensed light hydrocarbon mixture containing some water and filtration residues; it is estimated that these could comprise 2-12% of the total feed. A more exact estimate will depend on the source of the oils, and for purposes of cost estimation is assumed to be 6%. Residuals above 12% would inhibit processing of the used oils. These materials would be disposed of off-site at a permitted facility for treatment or incineration.

The facility would be able to handle waste oils and sludges received in drums or bulk. Generally most of the waste oil received is suitable for producing a useable product. However, some excess water bottoms may be produced as a waste.

A central facility to serve Montana would require a capacity of 8000 gallons per day, assuming one shift of 8 hours per day for 250 working days per year. This is a yearly capacity of 2,000,000 gallons per year. Ultimate facility throughput would probably range from 1.5 to 2.0 million gallons per year.

The ability to homogenize fuels to make a stable mixture of oil, water and suspended solids adds to the commercial value and volume of oil eligible for reclamation.

Operating Experience

There are many facilities in the United States which receive and treat waste oil for recycling as fuel. Reprocessing facilities vary in complexity and process control and in the quality of product and volume of residuals produced. Petrocon of Modena, PA, recycles approximately 7.5 million gallons of used oil per year mainly for use as fuel, while ILWD, Inc. of Indianapolis, IN, re-refines oil for use both as lubricating oil and fuel.

Suitable Wastes

Halogen levels in non-hazardous waste oils destined for burning are limited to 1000 ppm. As previously indicated, halogen levels indicate the amount of fluorine, chlorine, bromine, iodine or astatine that are present in the used oil. This regulatory limit would affect the quantity of waste oil suitable for reclamation under non-hazardous criteria. The impact of this limitation can be reduced by requiring generator segregation of solvents from waste oils.

Existing Potential Markets

The heating value of recovered oils is sufficient to make such oils a salable commodity with the economic value of waste oils as fuel varying typically from 60 to 90% of virgin fuel value. A sliding scale of charges for acceptance of waste oils for reclamation could be used according to the percentages of water and solids in the waste oil.

A central facility would have two grades of fuels as product. The better grade would command a price equal to 60 to 90% of virgin fuel prices, while the lower grade with a minimum heating value would probably carry a negative value; that is, one would have to pay for disposal. A combination of grades, possibly including waste solvents from another facility, would be the ultimate goal, with economics favorable to both the user and the central facility.

To evaluate the potential feasibility of utilizing used oil as a fuel source on a regional or statewide basis, the consultant identified several existing operations that could potentially burn used oils. In implementing such a program it is most desirable to contract with an operation that could handle large volumes of the recycled oils in comparison to locating several smaller operations.

Some of the operations in the state that have large boilers and high fuel demands as well and should be relatively inexpensive to convert to burn used oil are summarized below:

Cement Plants. There are two plants located in Montana that produce Portland Cement. Ideal Basic Industries operates one in Trident. The second is operated by Ash Grove Cement West, Inc. at Montana City. Each plant produces approximately 200,000 tons of cement annually.

For each plant, a combination of pulverized coal and petroleum coke is utilized to provide the necessary heat in the kiln. Because temperatures in these kilns reach approximately 3000 degrees Fahrenheit, virtually total destruction of the used oils can be expected. Additionally the energy demand of either cement plant substantially exceeds the cumulative heating value of all the used oils in the state.

Corrette Electrical Generating Plant. The Montana Power Company's Corrette generating plant located in Billings is another potential market application for burning used oil. The plant has the capability to produce 150 megawatts. Under these conditions the plant utilizes approximately 1,500 tons of coal in a 24-hour period. The plant is also capable of burning natural gas. This plant's energy demand would far exceed the cumulative heating value of all the used oil in the state.

Colstrip Electrical Generating Plant. The Montana Power Company along with other utility companies own and operate an even larger electrical generating plant in Colstrip. The coal-fired plant has 2-500 megawatt and 2-750 megawatt units.

MDU Electrical Generating Plant. The Montana Dakota Utilities Company operates an electrical generating plant in Sidney. The plant utilizes a 50 megawatt unit. The plant utilizes approximately 300,000 tons of coal annually to fire the boiler.

Other Large Steam and Electrical Generating Plants. In addition to the cement and power plants described herein, there are several facilities in the state that utilize a substantial amount of natural gas, fuel oil and/or coal to fuel their boilers. These facilities would also be possible candidates for burning used oil to partially replace their existing fuel source. Some of these large facilities are listed below:

1. Malmstrom AFB Generating Plant - Great Falls
2. Montana State University Central Steam Plant - Bozeman
3. University of Montana Central Steam Plant - Missoula
4. Stauffer Chemical Co. Steam Plant - Butte
5. Champion International Steam Plant - Missoula
6. Plum Creek Steam Plant - Columbia Falls

Central Used Oil Processing Facility - Economic Analysis

Facility Costs

A used oil recovery facility, capable of recycling 2 million gallons per year of used oil as fuel, has an estimated capital cost of $300,000 (excludes capital cost of transportation system, since many lease/own options are available). O&M cost for a facility of this type is approximately $500,000 per year or $.25/gallon. Transportation costs are estimated to be approximately $100,000, averaging $.05/gallon. Residual disposal are estimated to be approximately $360,000, or $.18/gallon.

Potential Revenue

Potential revenue from used oil fuel must be calculated on the basis of regional prices for virgin fuel oil; recycled used oil is usually priced to be 10-20% lower in cost than the equivalent virgin product. As an estimate, #2 grade virgin fuel oil used extensively in Montana is presently selling for approximately $.60/gallon. Potential revenue from sales of 2 million gallons of fuel oil at a range of $.50/gallon to $.60/gallon is estimated at $1,000,000 to $1,200,000.

Competitive Operations

No facilities are currently available in Montana to process waste oil for use as fuel. Currently there are several marketers operating in the state that collect used oil from generators. It is anticipated that these markets would continue to collect and transport the used oils to a central facility if a statewide facility were implemented. These marketers would either get reimbursed for their efforts or have to pay a drop charge at the facility depending upon the market conditions and value of the used oil. In most cases the value of the used oil will vary from time to time depending upon the cost of crude oil. Therefore the subsequent drop charge or revenue would vary also.

Individual Heating Units

As previously noted, individual heating units in which off-specification used oil can be burned are constrained by existing regulations to:

1. Burn only used oil that the owner or operator generates or used oil received from do-it-yourself oil changers who generate used oil as household waste;

2. Have a maximum capacity of not more than 0.5 million BTU per hour, and

3. Vent combustion gases to the ambient air.

Assuming virgin oil prices of $0.45/gallon to $0.60/gallon, a heating unit size of 150,000 BTU/hr, and use of such a unit 8 hours a day, 150 days/year, a cost savings of $630 - $840 per year would be realized by burning used oil in such a boiler. However, the purchase price of a unit of this size is estimated to be approximately $4500. It is expected that the economic attractiveness of such a boiler will be highly variable. It appears that at current virgin fuel oil prices, the payback on the capital investment would be approximately 5-7 years.

Comparison of Alternatives

A cost summary for the following three waste oil options is given in Table 3-1:

- Option #1: All wastes are brought to a central processing facility with the product utilized at a nearby existing fuel user such as a power plant or cement kiln.

- Option #2 Equivalent to Option #1 with the exception that the user's fuel demand conditions would require that the processed used oil be blended with a 50% mixture of virgin oil.

- Option #3 An individual installs a heating unit in their home or place of business.

Based on the cost estimate depicted herein, the total net cost for disposal would vary from $0.00 to $0.19 per gallon depending upon the option. These estimated costs can be compared to disposal costs currently being charged by marketers in the state of $.20 to $.25 per gallon.

It is anticipated that ultimately more of the larger used oil generators that have the storage facilities and sufficient energy demands may install used oil burning units. For the remaining used oil generators that do not have sufficient demand or the proper conditions to burn used oil or simply do not wish to

Table 3-1
Waste Oil Options Cost Summary

Option	Capacity (gallons/year)	Capital Cost	Annual Amortization of Capital (15 yrs@10%)	Annual Operations & Maintenance	Annual Transportation	Residuals Disposal (6%)*	Total Annual Cost	Potential Annual Revenue	Net Cost **	Net Cost per gallon**
Waste Oil Options										
Central Facility-Fuel Processing	2000000	$300,000	$40,000	$500,000	$100,000	$360,000	$1,000,000	$1,000,000	$0	$0.00
*Central Facility with Need for 50% Blending	2000000	$300,000	$40,000	$1,400,000	$100,000	$360,000	$1,900,000	$1,520,000	$360,000	$0.19
Individual Heating Units	1400	$4,500	$600	$50	$0	$252	$902	$630	$20	$0.01

*Assumes an average disposal cost of $150/drum, or approx. $3/gal.
**Net costs indicated herein compare to existing current disposal costs charged by marketers of $.20 to $.25 per gallon

handle the used oils, it may be feasible to implement a regional or statewide used oil collection and utilization program.

Assuming that burning of used oils in individual boilers is practiced to the fullest extent safely possible, potential alternatives to a central facility for used oils for use as fuel includes two options: shipment out of state, or recovery as a purified product suitable for re-use. Depressed fuel prices and high costs of freight make out-of-state shipments costly. Purification of waste oils to produce lubricating products that equal or exceed original specifications is technically possible but not currently practical based on cost-benefit considerations. This is particularly true for waste automobile crankcase oils; purification of oils back to original specification requires extensive, multi-process treatment, which is extremely expensive. Purification is therefore not usually a cost-effective alternative. Specialty oils such as hydraulic oils and turbine oils may be recovered for re-use, but represent a relatively small market outlet for this material.

In light of the decreasing number of disposal options available, potential mismanagement of this material, the magnitude of the potential market for used oil fuel in Montana, and the quality control and economic attractiveness of a central facility, a fuel recovery facility appears to be a viable option for future management of used oils in Montana. It should be investigated in detail.

SECTION 4

ANALYSIS OF THE MANAGEMENT OF USED SOLVENTS

SECTION FOUR

ANALYSIS OF THE MANAGEMENT OF USED SOLVENTS

Introduction

The purpose of this chapter is to evaluate the management of used solvents in Montana. The sections within this chapter discuss the following:

- Regulatory status
- Current management methods
- Discussion and selection of alternatives
- Evaluation of alternatives

Regulatory Status

Spent solvents are defined as follows: no longer fit for use without being regenerated, reclaimed, or otherwise reprocessed. As required by the Hazardous and Solid Waste Amendments of 1984, EPA restricted the land disposal of five categories of solvent wastes. They are EPA Waste Codes F001, F002, F003, F004, and F005, which consist of certain spent halogenated and non-halogenated solvents, along with sludges or still bottoms from the recovery of these solvents. According to the final rule, these solvent wastes must meet new technology-based treatment standards before land disposal will be allowed. This land disposal ban took effect as of 8 November 1986.

The land disposal restrictions apply to spent solvent mixtures containing a total of >10% (by volume) of one or more of the F001-F005 solvents. The land disposal restrictions do not apply to some newly listed F002 and F005 solvents, or solvent commercial chemical products, manufacturing chemical intermediates, and off-specification commercial chemical products.

The 7 November 1986, regulations also extended the effective date for the land disposal restrictions to 8 November 1988 for three types of solvent wastes due to a shortage of capacity at existing disposal facilities. The three wastes are:

1. Wastes generated by small quantity generators (SQGs).
2. Wastes generated from Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 104 or 106 response actions (Superfund wastes) or RCRA corrective action,
3. Solvent wastewater, solvent-containing sludges, or solvent-contaminated soils containing < 1% total F001-F005 solvent constituents.

Parties subject to the land disposal restrictions may be able to postpone or obtain exemptions for the requirements via "no migration" exemptions, extensions of effective dates, or treatability variances.

Solvents - Current Management Methods

Results of Survey

Extrapolated estimates of management methods currently employed by SQGs and VSQGs in Montana, as obtained from the survey, are presented in Figure 4-1. Further breakdown of the data is presented in Appendix C. The majority of SQG-generated solvent is sent off-site for recycling (28%) or burned on-site for fuel value. The VSQGs again show a wide range of management alternatives. The majority of these solvents are hauled off-site to a landfill (31%), recycled off-site (20%), or burned for fuel value on-site (11%) or off-site (8%). A range of on-site land disposal options are also utilized.

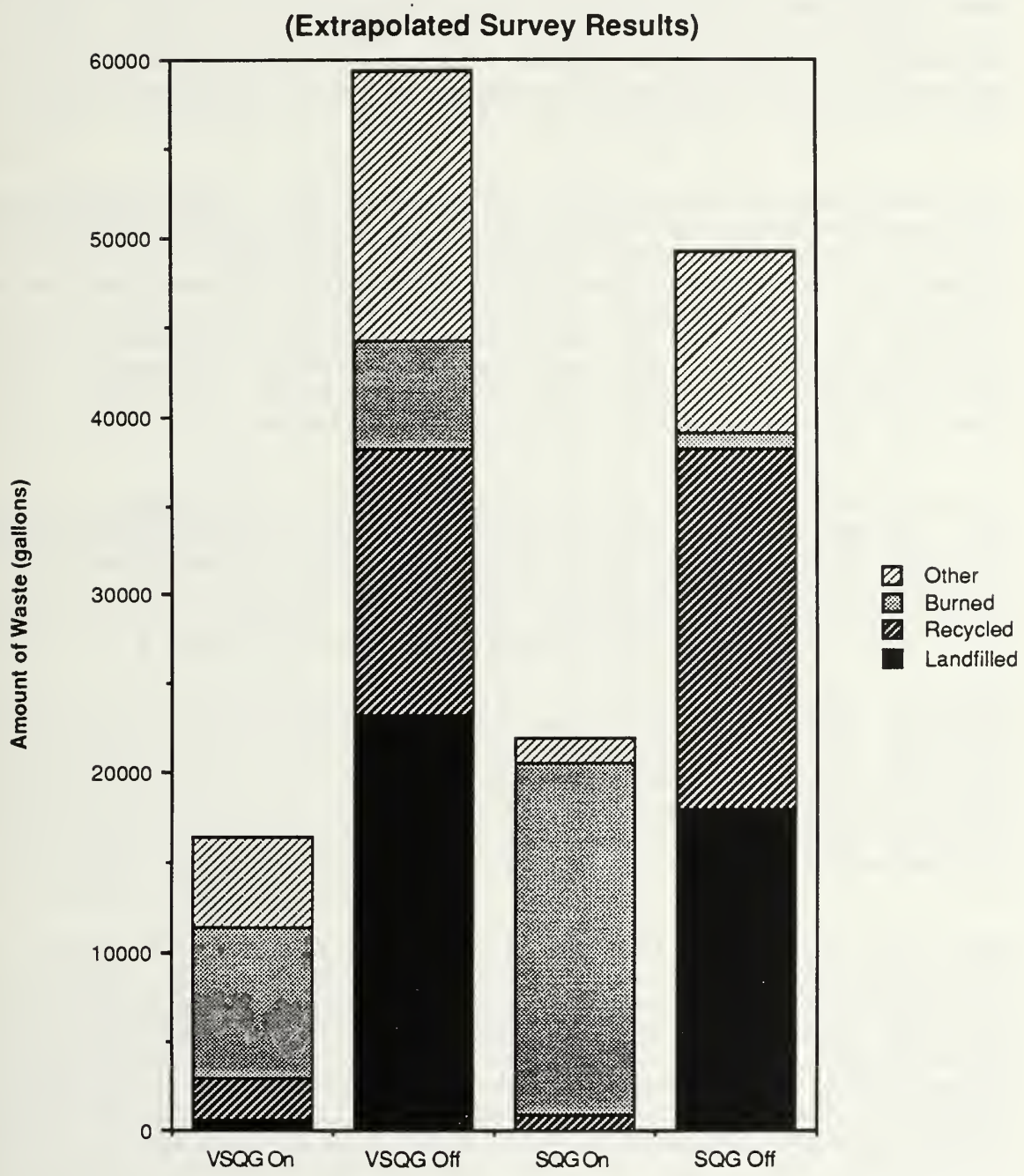
Results of Interviews

Three major categories of final disposition of solvents can be established: 1) recycling/disposal by a licensed hazardous waste facility, 2) individual reclaiming stills, and 3) illegal disposal. During the project the consultant randomly interviewed several individuals involved in the generation, handling, recycling or disposal of solvents generated in the State. Based on these interviews, the following general conclusions within each category can be drawn.

Licensed Facilities

Landfilling. As a result of the interviews conducted for this project, it became very apparent that solvents for the most part are not being accepted at Class II landfills in Montana.

Figure 4-1
Used Solvents Management Practices



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Although the State and Federal laws allow very small quantity generators of hazardous wastes (those who generate less than 100 kg per month) to utilize Class II sanitary landfills, most landfills in the state prohibit the disposal of free liquids. Of the few landfills that do accept small quantities of hazardous wastes, each requires that the solvents be solidified or absorbed by an approved method. This also is consistent with the state policies.

Contract Services. The results of the interviews indicated that approximately 20 companies in Montana have shipped solvents to hazardous waste disposal sites outside Montana. In all but two instances the generator utilized a licensed transporter to handle these solvents. In most cases the generators's total cost including transportation and disposal was in the range of $100 to $500 per 55-gallon drum depending upon the type and quantity of solvent. There are firms located in and outside of Montana that will contract with generators to provide this type of disposal service.

Reclaiming Services. Safety Kleen, a national corporation, is currently operating a reclaiming service for solvent users. The Montana operation for the company is currently based in Spokane. In the near future the existing service that is currently being offered only in western Montana is expected to expand to central Montana when a Helena center is established later in 1987.

Safety Kleen's solvent reclamation service basically includes providing its customers a parts washing unit that filters solvents as they are used. The necessary size of the unit depends upon the volume of solvent utilized. Safety Kleen's personnel periodically travel to each customer's facility, clean the unit, pick up the used solvent and drop off reclaimed solvent. This process alleviates the need for each individual business to dispose of the used solvents.

There are other companies that have recently indicated that they will provide a similar type service as well. One such company is Special Resources Management, Inc. (SRM) which has indicated its intent to provide collection, disposal and reclaiming services for generators of used solvents in its service area. SRM, which is a subsidiary of the Montana Power Company, is a corporation based in Butte and Billings which recently was formed to provide hazardous waste management services in Montana, North Dakota, South Dakota, Wyoming, and Idaho.

Individual Reclaiming Stills

Many of the establishments that were interviewed indicated their intention of purchasing small distillation units. A number of businesses already have this type of unit in operation. The

smaller units for sale are capable of distilling up to 5 gallons in one batching operation which typically will take approximately 8 hours. The specification of the equipment indicate recovery rates of 80-95%, producing a reusable product of 99% purity. Typically, the remaining residues (commonly referred to as "still bottoms") are stored and must be disposed of periodically. The smaller units typically are selling for approximately $3,000.

Since most small businesses do not generate solvents in sufficient volumes to justify a still, the concept of several businesses jointly purchasing a unit is becoming increasingly popular. To meet the permitting requirements, however, the unit must be rotated to each business rather than each business transporting their individual wastes to a central location where the unit could be operated.

Storage

Many of the small generators indicated that the proper handling of the solvents was either cost prohibitive or the basic disposal or recycling services were not available. These individuals for the most part indicated that they are currently storing the solvent and waiting for an economical service or program to be implemented, or disposing improperly of the waste.

Selection of Alternatives for Further Evaluation

Overview

Basically there are three options available for handling used solvents:

1) Individual generators or a small group of generators purchasing a distillation unit and reclaiming the solvents,

2) Individual generators contacting companies capable of transporting and disposing of the solvents at existing or portable reclaiming facilities or hazardous waste disposal sites (which would require transporting these solvents out of state since no in-state hazardous waste reclaiming or disposal facilities exist), and

3) Implementation of a statewide collection and recycling program using a central facility and/or mobile (units).

As indicated, there are a number of large and small generators of solvents in the state that have either purchased or are contemplating purchasing distillation units. This alternative is

an established and viable option, and is expected to continue. However, it is assumed that the feasibility of this option is highly individualized, and if the option is implemented, results in on-site treatment of waste.

Many smaller generators are utilizing or plan in the future to utilize Safety Kleen, SRM or other companies to reclaim their used solvents. Several of the larger solvent generators in the past have contracted with firms to dispose of their solvents at hazardous waste sites. It is quite likely that many of these generators will continue to utilize these practices. Because the commercial hazardous waste market is always a viable alternative for those who can be served by it, it too should be considered further.

Because a substantial number of generators in the state do not have access or can not afford one of these waste solvent outlets, the alternative of implementing a statewide recovery and recycling/disposal plan should also be evaluated. The general concepts considered applicable under this alternative include:

1) Utilize an existing central facility with a fuel demand sufficient to burn a majority or all of the solvents generated in the state,

2) Construct and operate a central facility whereby the solvents generated in the state could be processed and ultimately reused by the generators, and

3) Implement a system consisting of a portable distillation unit(s) that would travel the state and process various generators' solvents.

Central Facility With Demand For Fuel

Description of Operations

EPA presently distinguishes between the burning of solvents for energy recovery and the incineration of solvents as a waste disposal method. The BTU content of the solvent used as a supplemental fuel determines which category a given combustion process falls into and, hence, the set of regulations with which the facility burning solvents must conform. Solvents are considered to be incinerated when their BTU value is less than that for low-energy fuels such as wood or low-grade coal (5,000-8,000 BTU/lb.) Carbon tetrachloride, dichloroethanes, dichloroethylene, methylene chloride, chloroform, perchloroethylene, 1,1,1-trichloroethane, and trichloroethylene all have net heating values of less than 5,000 BTU/lb. In contrast, non-halogenated solvents, such as the aromatics,

alcohols, and ketones, have heating values in excess of 8,000 BTU/lb and burning of these substances as a fuel is considered reuse or reclamation of these wastes.

Hazardous wastes can only be incinerated in a hazardous waste incinerator. Such a facility is subject to the requirements of RCRA as set forth in 40 CFR 260 et seq. In contrast, any industrial process may presently burn hazardous wastes as a fuel without the need for a trial burn and a Part B permit under 40 CFR 270. The term "industrial furnace" as defined in the recent amendments to 40 CFR 260.10 (50 FR 661) includes those devices that are integral components of manufacturing processes that use flame combustion or elevated temperatures to accomplish recovery energy or materials; devices listed in the definition are cement kilns, lime kilns, aggregate kilns, phosphate kilns, coke ovens, blast furnaces, smelting furnaces, and others. All that is required, theoretically, is that a Part B permit be obtained for the storage of the waste solvents. However, proposed rules published May 6, 1987, would establish technical controls for the burning of hazardous waste fuels in boilers and industrial furnaces irrespective of the heating value of the waste. These controls would include limits on emissions of toxic organic compounds, toxic metals and hydrogen chloride. In addition owners and operators of these facilities would be subject to the general facility standards applicable to hazardous waste treatment, storage, and disposal facilities.

Facilities suitable for burning solvent mixtures for energy recovery, subject to the BTU content limitations discussed above, include cement kilns, lime kilns, blast furnaces, and coke ovens. These processes provide the retention time, turbulence, and temperature necessary to oxidize completely the original compounds; not all boiler furnaces have this capability. Cement and lime kilns are particularly appropriate for burning chlorinated solvent mixtures, since halogenated gases are converted in the alkaline kiln environment into chloride salts. In many other combustion processes, the combustion products of chlorinated compounds condense as hydrochloric acid or exit the stack as chloride salts. There are currently no federal limitations on halogen content in solvent mixtures destined for burning.

Suitable Wastes

Because of flashpoint and volatility considerations, systems which burn solely solvents are not normally used. Not all solvent waste is suitable for use as a fuel in industrial furnaces. It must have a relatively high energy value (a net heating value of about 10,000 BTU/gallon is suitable), and the metals content should be generally low. The metals may affect product quality in direct heat exchangers such as cement kilns,

or they may change character of the flue gas emissions, necessitating modification to the emissions control system, or even requiring that the collected dust be handled as a hazardous waste. Chlorinated compounds could cause corrosion problems. Solids content can be a problem as well. The consumer of fuel should specify the maximum allowable solids content and size to prevent burner nozzle pluggage and pump damage. Viscosity of the final blend also must be limited as required for the system's pumps and burners. Many specifications may be of concern to the permitting agency and, in fact, may be dictated by that body. Therefore, solvents usually must be brought to a central point for blending and quality control.

Potential Markets

Available markets for blended solvent fuels are the two cement kilns listed in Section Three for used oils. It should be noted that used solvents and oils can be blended for use as an effective fuel. It should be pointed out, however, that if used oils and solvents are blended the entire mixture may be considered hazardous and correspondingly more stringent regulations may apply. Thus, any blending of oils and solvents should be initially evaluated in substantial detail.

Summary of Feasibility

According to recent sources, the smallest fuel blending program that can feasibly be implemented is a 1 million gallon per year facility. In order to achieve this in Montana, the facility would require an annual minimum of 850,000 gallons of used oil to be blended with the solvents since the state of Montana only generates an annual total of approximately 150,000 gallons of used solvents. Since it is impractical at this time to expect that such a facility would capture all of the annually generated solvents, it is most likely that only 10% or less of the facility's total capacity would be satisfied by used solvents. Based on this, the feasibility of handling solvents in this manner in Montana is directly dependent upon the feasibility of implementing a central used oil processing and utilization program. According to preliminary cost estimates, the costs to handle solvent under a blending program are about double the cost of implementing a reclaiming program. The estimated costs of implementing a reclaiming program are discussed in the following pages.

Central Reclaiming Facility - General Concepts

Description of Operations

A central recovery facility for solvents would employ distillation and filtration processes. Distillation is a means of purifying solvents for re-use, effecting separation from water (if present), and separating liquid solvents from accompanying sludges that are gummy in nature and cannot be readily filtered. Since solids in the solvent mixture can foul column packing, filtration of solvent mixtures that contain discrete and readily filtered solids is also necessary. Most solvents have a low boiling point and require relatively small amounts of heat to evaporate a unit weight of solvent. Thus, recovery of a solvent by distillation is an energy-efficient process.

Two main types of distillation processes are in use: continuous distillation and batch. In the continuous process, waste is fed into the middle of the distillation column. Volatile constituents in the influent are concentrated in the upper half or "enrichment" section of the column, while less volatile components, such as water, are concentrated in the lower half, or "stripping" section, of the column. To further enhance the concentration of volatile components in the column overhead, liquid from the condenser is routed via the accumulator (or receiver) back to the top of the column as a countercurrent stream to the rising vapors.

In the batch distillation process, there is no "stripping" section of the column. Waste is fed directly to the reboiler and, hence, the column functions to concentrate only the volatile components of the feed. Partial recycle of condensate to the top of the column as a countercurrent liquid stream to the rising vapors is also employed in the batch process to further separate volatile constituents from the column feed.

Distillation equipment consists of a distillation column containing tray packing (or random packing for small units) with an internal or external heat source (usually a steam coil) for vaporizing volatile in the feed. Vapors off the top of the column are collected in a condenser and pass as a liquid to an accumulator, from which the reclaimed solvent is collected. A portion of the condensate is often recycled to the column to improve tower treatment efficiency. Non-volatile still bottoms are removed from the base of the column in batch distillation or from the external reboiler in continuous distillation.

Batch distillation is generally preferred over continuous distillation for waste solvent reclamation since the batch process is not as capital intensive and is more easily operated. While reclaimed products of higher purity can be obtained via

continuous distillation, markets are available for lower purity mixed solvents. Because of the wide variety of solvents expected to be reclaimed at a central facility, the expense of continuous distillation is usually not justifiable.

A facility designed to receive, analyze, purify, blend and store solvents can safely handle a wide range of solvents and oversee the directing of recovered solvents to the proper end-use, as has been demonstrated by existing solvent reclaim facilities.

Operating Characteristics

Waste solvents would be received in drums, analyzed, and stored in the original drums according to solvent type and anticipated treatment method.

Two separate solvent recovery facilities, one for halogenated hydrocarbons, and one for non-halogenated hydrocarbons would be necessary to adequately reclaim solvents from diverse sources. Mixtures of halogenated and non-halogenated solvents would be treated as halogenated solvents. The capacity of the still for halogenated solvents would be on the order of two drums per batch (100 to 110 gallons). The facility for non-halogenated solvents would have a capacity of eight drums per batch operation (400 - 440 gallons). It is anticipated that the solvent recovery facility could accomplish two batch distillations per 8-hour day. Segregation of halogenated and non-halogenated solvents is necessary, since these two classes of solvents are reclaimed to different uses depending on their halogen content.

The distillation equipment is conceived as a still or pot with a steam coil. Steam at 300°F or higher and 100 pounds per square inch would be used for heating the influent solvent mixture via a closed heating coil. The process would be operated in batch mode.

The distillation would serve to separate the solvent mixture from water and residues. Solvent mixtures would not be further separated into individual organic compounds in the batch distillation. The additional process refinement required to segregate mixed solvents into separate high-purity solvents is not thought to be economically justifiable, given the available market for mixed solvents.

Operating Experience

Distillation of solvents for recovery and re-use is a well-known process. One complicating factor in recovery of solvents in pot stills is the necessity to clean out residues. Adding an organic liquid which has a high boiling point to the feed can simplify cleaning out solids from the pot still. The volatile solvents

are boiled off, and this high boiling liquid which is added remains in the still. The solids and sludges remain suspended in this high boiling liquid and can be pumped out of the still for cleaning. Residues can range from 2-12% of the incoming feed; percentages greater than this may foul processing equipment.

Suitable Wastes

Suitable wastes for a facility of this type are a wide range of spent halogenated and non-halogenated solvents.

Central Reclaiming Facility - Economic Analysis

Facility Costs

A central solvent recovery facility with a capacity of approximately 150,000 gallons per year has an estimated capital cost of $150,000 without land and utilities. Operation costs for two men per shift, 8-hours per day, five days per week, would be about $45,000 per year with benefits. Additional costs, such as utilities, would be another $0.10 to $0.15 per gallon. Residual disposal costs are estimated to be $27,000 per year.

Potential Revenue

The market for recovered halogenated solvent mixtures suitable for de-greasing and de-oiling of metal parts is good. Such mixtures sell for $1.00 per gallon minimum to $1.80 to $2.00 per gallon. The recovered material can be a mixture of such solvents as 1,1,1-trichloroethane, trichloroethylene, perchloroethylene, and carbon tetrachloride in any proportion of any component.

The market for non-halogenated solvents exists for relatively pure recovered solvents ($0.90 to $1.20 per gallon); mixed recovered solvents, or "wash" solvents ($0.60 to $0.80 per gallon); and lower-grade solvents and non-halogenated organic sludges for fuels or fuel supplements at $0.10 to $0.20 per gallon, depending on heating value of the fuel.

Competitive Operations

There are no known permanent commercial solvent recovery facilities in the State of Montana. Collection networks and costs for statewide or regional collection of hazardous wastes are discussed in the hazardous Waste Management Options Study. Present estimates of the cost to transport the solvents from the generators to a central facility are approximately $50/drum or $1/gallon.

Mobile Facility - General Concepts

Description of Operations

A mobile solvent recovery unit consists of trailer-mounted equipment for distillation and filtration. Recovery operations would be carried out at the generator's site. The mobile facility would be self-contained and have its own power generator, cooling system, and laboratory facilities. The trailer would be 8 ft by 40 ft, which is a standard size.

Electrical power would be produced by a diesel-driven generator having a capacity of about 30 kw. Heating would be accomplished by an electrically-heated, hot-oil circulation system. Provision for cooling would consist of a closed water circulation system in summer and an air-cooling system in winter.

The distillation unit would be a pot still that could handle two drums of solvent at a time. Two distillations per 8-hour day could be accomplished, giving a capacity of four drums of solvents per day. A series of filters would be placed upstream of the distillation unit.

Operating Experience

Mobile units for on-site processing are experiencing increased demand as the shortage of other central treatment facilities becomes more acute. There are no operational limitations peculiar to mobile units that would restrict the application of such units. Air pollution control equipment such as vapor-phase carbon would be required on the vent system of the distillation column and condenser.

There would be residues from filtration and bottoms left in the pot still after a distillation, and may be up to 12% of the incoming feed. Use of a high boiling liquid in the pot still to facilitate clean-out should be considered. All residues would be collected in drums during daily operations and be handled at a central treatment or transport facility for disposal.

Potential Markets

Solvent recovery via a mobile unit is typically appropriate for generators producing fewer than six drums of waste solvents per year. The mobile unit is sized to accommodate the smaller generator. Large generators would probabley require other means of solvent recovery and could best use a central recovery system.

A summary of data from the Waste Survey show that 90 percent of the generators produce six drums or fewer per year of waste

solvents. These same generators account for about 50 percent of the total waste solvent volume, or 70,000 gallons per year.

Generators surveyed showed the following breakdown in solvent generation:

Solvent Quantity (Drums/year)	No. of Generators
1 to 2	152
3 to 6	61
7 to 10	10
over 10	10

The majority of generators of waste solvents might therefore benefit from a mobile facility, although each generator would have to be evaluated individually. A mobile unit as described could process about 40,000 gallons of waste solvent per year, allowing for 30 percent downtime due to travel, weather conditions and the like. In the event that this capacity is not sufficient to satisfy demand, more than one mobile unit could be placed into service rather than trying to increase the capacity of the existing unit over that recommended.

Mobile Facility - Economic Analysis

Facility Costs

A mobile facility complete with laboratory is estimated to cost about $90,000, including the trailer but not including the tractor. A single-drive axle tractor would suffice. Assuming the tractor cost at about $45,000, total cost for the mobile unit would be about $135,000. Including depreciation, manpower, fuel, maintenance, insurance, and residuals disposal costs, total annual cost for operation of the mobile recovery facility would be about $68,000.

Potential Revenue

Potential revenue from the operation of a mobile facility would be the value of the recycled product to the generator. Currently, generator costs for purchased solvent and spent solvent disposal could approach $3.00/gallon. Typically, however, an average potential revenue for reclaimed solvent will be in the $1.00 to $2.00 per gallon range. For the economic analysis summarized herein, a conservative value of $1.00 per gallon was used.

Competitive Operations

Relatively few privately-owned mobile units are known to exist at this time. However, recently SRM has indicated the possibility of providing a mobile reclaiming service to operate within their service area.

Comparison of Alternatives

A cost summary for the central reclaiming facility option and the mobile reclaiming option are depicted on Table 4-1. As indicated on the table, the net cost to dispose of the solvents varies from $0.71 to $0.78 per gallon with the mobile option slightly less expensive. Disposal at a permitted facility through commercial waste disposal companies is possible but expensive when compared to the options presented in this analysis. The small generator also finds disposal through commercial facilities difficult because of the small solvent quantities involved. Solvents cannot be disposed of directly in a landfill, although stabilization or absorption of solvents and subsequent landfill disposal may be permitted on a case-by-case basis. Disposal to a commercial waste disposal facility without considering re-use or recovery of heating value would likely be more costly, especially to the small generator. Current spent solvent disposal costs are in the range of $200 to $300 or more per drum ($4 to $5 per gallon) for halogenated hydrocarbons and $80 to $200 per drum ($1.50 to $4.00 per gallon) for non-halogenated solvents.

Table 4-1
Waste Solvent Options Cost Summary

Option	Capacity (gallons/year)	Capital Cost	Annual Amortization of Capital (15 yrs@10%)	Annual Operations & Maintenance	Annual Transportation	Residuals Disposal (6%)*	Total Annual Cost	Potential Annual Revenue	Net Cost **	Net Cost per gallon **
Waste Solvent Options										
Central Facility-Reuse	$150,000	$150,000	$20,000	$70,000	$150,000	$27,000	$267,000	$150,000	$117,000	$0.78
Mobile Facility	$40,000	$135,000	$18,000	$43,000	$0	$7,200	$68,200	$40,000	$28,200	$0.71

*Assumes residue disposal cost of $150/drum, or approximately $3/gal.
** Net costs indicated herein compare to costs for transport and disposal at a licensed hazardous waste facility varying from $1.50 to $5.00 per gallon

SECTION 5

SUMMARY AND RECOMMENDATIONS

SECTION FIVE

RECOMMENDATIONS

Used Oils

Used oil disposal in Montana is currently a fluctuating practice. In the past when virgin crude oil prices were high, there were numerous outlets for used oil. This resulted in numerous marketers traveling the state and paying generators up to $0.25 per gallon for their used oils. However, a decline in crude oil prices coupled with the fact that use of used oils for dust suppression on roadways has been drastically reduced has caused many marketers to go out of business due to the lack of possible market outlets. Market conditions have also forced marketers still in the business to charge up to $0.25 per gallon to dispose of individual generators' used oil. Consequently many generators are being forced to stockpile their used oils due to the lack of available marketers and the high cost of disposal.

Due to the poor market conditions of disposing of used oils, there are many individual companies that are purchasing oil fired space heaters. According to estimates prepared for this study (see Table 3-1), the net cost to dispose of used oils using an individual space heater designed to burn used oil could be approximately $0.01 per gallon. This compares to current disposal costs of $0.20 to $0.25 per gallon if "marketers" are called upon to pickup and dispose of oils at businesses, etc. Accordingly, many companies in the state are contemplating purchasing used oil space heaters to heat their businesses and/or shops.

Various conditions, however, dictate that not all used oil generators are able to purchase and utilize oil fired space heaters. It is estimated that the majority of oil generators in the state are not able to utilize these units due to limited heating requirements, existing physical conditions of their building and/or site, etc. For these situations, it appears feasible to implement a program whereby the used oils generated in the state could be transported to a central facility. At this facility the oils would be processed and filtered for use as a fuel. This study has identified several large fuel users in the

The ERM Group

state that could directly use these reprocessed oils. According to the economic analysis contained herein (see Table 3-1), the net cost for this option would vary from $0.00 per gallon to $0.19/gallon, depending upon the market driven price of the produced fuels and volume of virgin fuel that would have to be blended with the used oils.

Based on this analysis, it is recommended that where feasible individual used oil space heaters should be utilized. For the remainder of the used oils generated in the state, it is recommended that a detailed study be conducted to finalize the economic feasibility of implementing a centralized processing and reuse facility. It appears that these two options should handle both the large used oil generators and the small generator at a cost that is extremely competitive or more attractive than existing disposal practices.

Used Solvents

According to the interviews, surveys, and field work conducted for this study, generators of solvents in Montana have found that the disposal of solvents at licensed hazardous waste sites is possible but quite expensive. Especially for the very small quantity generators, disposal through commercial facilities is difficult because of the small quantities involved and large distances to the licensed disposal sites. Additionally, SQG-generated solvents cannot be legally disposed of at sanitary landfills in the state unless the solvents are absorbed or solidified. Disposal at commercial facilities are in the range of $200 to $300 or more per drum for halogenated hydrocarbons and $80 to $200 per drum for non-halogentad solvents.

For this study two basic alternatives for recycling solvents were identified as being potentially feasible. These options included 1) a central processing facility whereby the solvents generated in the state would be brought to a distillation facility for reclamation of the solvents, and 2) a mobile program where one or more mobile distillation units would travel to the individual generator's location and process the solvent for reuse. The net costs for these options are in the range of $35 to $40 per barrel. Therefore, these estimated costs are considerably less expensive than the current costs to dispose of the waste at out of state licensed sites.

Because of the high costs of disposal at out of state sites coupled with the economic attractiveness of recovering solvents for reuse, private firms have entered the marketplace to provide recovery services for solvents. Safety Kleen, a national firm that provides a reclaiming service for solvents, is currently servicing many generators in western Montana and has indicated the intent to expand to many areas of the state in the near future. Another firm, Special Resources Management, Inc., based in Montana has indicated the intent to possibly provide a mobile distillation unit(s) similar in theory to the option discussed in this study. Additional firms have also indicated their intent to serve the state in one capacity or another.

Based on the analysis conducted for this study, it is recommended that private enterprise take the lead at this time in providing reclaiming services to the solvent generators in the state. Correspondingly, the Dept. of Health personnel should monitor the effectiveness of these companies to make sure that the solvents generated in the state are being disposed of or recycled properly and legally. If in time it appears that private enterprise may need assistance to handle the solvent disposal situation, the state of Montana should strongly consider implementing a state-wide reclaiming program. The program could include the use of mobile units to handle the smaller generators and/or a central distillation facility to handle the larger generators.

APPENDIX A

INDUSTRIAL CATEGORIES USED IN THE U.S. EPA NATIONAL SMALL QUANTITY GENERATOR STUDY

TITLES

1. **Pesticide-End Users**

SIC 7992 Public Golf Courses
8421 Aboreta, Botanical and Zoological Gardens

2. **Pesticide Application Services**

SIC 0711 Soil Preparation Sevices
0721 Crop Planting, Cultivating, and Protection
0729 General Crop Services
0782 Lawn and Garden Services
0783 Ornamental Shrub and Tree Services
4959 Sanitorial Services
7342 Disinfecting and Extermination Services

3. **Chemical Manufacturing**

SIC 2819 Industrial Inorganic Chemicals
2820 Plastics Materials and Synthetic Rubber, Synthetic and Other Man-Made Fibers, except Glass
2861 Gum and Wood Chemicals
2869 Industrial Organic Chemicals, not elsewhere classified

4. **Wood Preserving**

SIC 2491 Wood Preserving

5. **Formulators**

SIC 2834 Pharmaceutical Preparations
2851 Paints, Varnishes, Laquers, Enamels, and Allied Products
2879 Pesticides and Agricultural Chemicals, not elsewhere classified
2893 Printing Ink
2899 Chemicals and Chemical Products, not elsewhere classified

6. **Laundries**

SIC 7215 Coin-Operated Laundries and Dry Cleaning
7216 Drycleaning Plants, Except Rug Cleaning
7217 Carpet and Upholstered Cleaning
7218 Industrial Launderers

7. **Other Services**

SIC 7260 Funeral Services and Crematories
7349 Cleaning and Maintenance Services to Dwellings and Other Buildings, not elsewhere classified

8. **Photography**

SIC 7332 Blueprinting and Photocopying Services
7333 Commercial Photography, Art and Graphics
7395 Photofinishing Laboratories
7819 Services Allied to Motion Picture Production
8411 Museum and Art Galleries

9. **Textile Manufacturing**

SIC 2230 Broad Woven Fabric Mills, Wool (Including Dyeing and Finishing)
2250 Knitting Mills
2260 Dyeing and Finishing Textiles, Except Wool Fabrics Knit Goods
2270 Floor Covering Mills

10. **Vehicle Maintenance**

SIC 0722 Crop Harvesting, Primarily by Machine
1600 Construction other than Building Construction - General Contractors
1794 Excavating and Foundation Work
4100 Local and Suburban Transit and Interurban Highway Passenger Transportation
4210 Trucking, Local and Long Distance
4300 U.S. Postal Service
4463 Marine Cargo Handling
5270 Mobile Home Dealers
5500 Automotive Dealers and Gasoline Service Stations
7512 Passenger Car Rental and Leasing, without Drivers

7513 Truck Rental and Leasing, without Drivers
7519 Utility Trailers and Recreational Vehicle Rentals
7530 Automotive Repair Shops
9221 Police Protection
9224 Fire Protection

11. **Equipment Repair**

SIC 4610 Pipelines, except Natural Gas
4800 Communication
5962 Automatic Merchandising Machine Operators
7620 Electrical Repair Shops
7694 Armature Rewinding Shops
7699 Repair Shops and Related Services, not elsewhere classified
7996 Amusement Parks

12. **Metal Manufacturing**

SIC 2514 Metal Household Furniture
2522 Metal Office Furniture
2542 Metal Partitions, Shelving, Lockers, and Office and Store Fixtures
2590 Miscellaneous Furniture and Fixtures
3350 Rolling, Drawing, and extruding of Non-Ferrous Metals
3390 Miscellaneous Primary Metal Products
3400 Fabricated Metal Products, Except Machinery and Electrical Equipment (exc. 347, 3482, 3483, 3489)
3470 Coating, Engraving, and Allied Services
3500 Machinery, except Electrical
3600 Electrical and Electronic (Machinery, Equipment, and Supplies (exc. 3691, 3692)
3691 Costume Jewelry and Costume Novelties, except Precious Metal
3692 Primary Batteries, Dry and Wet
3714 Motor Vehicle Parts and Accessories
3800 Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods; Watches and Clocks
3910 Jewelry, Silverware, and Plated Wire
3999 Miscellaneous Manufacturing Industries - Manufacturing Industries, not elsewhere classified
3964 Needles, Pins, Hooks and Eyes, and similar notions
3993 Signs and Advertising Displays
3995 Burial Caskets

13. **Construction**

SIC 1711 Plumbing, Heating (except Electrical), and Air Conditioning
1721 Painting, Paper Hanging, and Decorating
1743 Terrazzo, Tile, Marble, and Mosaic Work
1751 Carpentering
1752 Floor Laying and other Floorwork, not elsewhere classified
1761 Roofing and Sheet Metal Work
1793 Glass and Glazing Work
2451 Mobile Homes
2452 Prefabricated Wood Buildings and Components
4000 Railroad Transportation

14. **Motor Freight Terminals**

SIC 4231 Terminal and Joint Terminal Maintenance Facilities for Motor Freight Transportation

15. **Furniture/Wood Manufacturing and Refinishing**

SIC 2434 Wood Kitchen Cabinets
2435 Hardwood Veneer and Plywood
2436 Softwood Veneer and Plywood
2492 Paricleboard
2499 Wood Products, not elsewhere classified
2511 Wood Household Furniture, except Upholstered
2517 Wood Television, Radio, Phonograph, and Sewing Machine Cabinets
2519 Household Furniture, not elsewhere classified
2521 Wood Office Furniture
2531 Public Building and Related Furniture
2541 Wood Partitions, Shelving, Lockers, and Office and Store Fixtures
7641 Reupholstery and Furniture Repair

16. **Heavy Metal Users**

SIC 0724 Cotton Ginning
3211 Flat Glass

17. **Printing/Ceramics**

SIC 2640 Converted Paper and Paperboard Products, except Containers and Boxes
2650 Paperboard Containers and Boxes
2700 Printing, Publishing, and Allied Industries
3251 Brick and Structural Clay Tile
3253 Ceramic Wall and Floor Tile
3260 Pottery and Related Services
7312 Outdoor Advertising Services
7331 Direct Mail Advertising Services

18. **Cleaning Agents and Cosmetic Manufacturing**

SIC 2841 Soap and other Detergents, except Specialty Cleaners
2842 Specialty Cleaning, Polishing, and Sanitation Preparation
2843 Surface Active Agents, Finishing Agents, Sulfonated Oils and Assistants
2844 Perfumes, Cosmetics and other Toilet Preparations

19. **Other Manufacturing**

SIC 3079 Miscellaneous Plastic Products
3100 Abrasive Products
3293 Asbestos Products

20. **Paper Industry**

SIC 2611 Pulp Mills
2621 Paper Mills, except Building Paper Mills
2631 Paperboard Mills
2661 Building Paper and Building Board Mills

21. **Analytic and Clinical Labs**

SIC 7391 Research and Development Laboratories
7397 Commercial Testing Laboratories
8062 General Medical and Surgical Hospitals
8069 Specialty Hospitals, except Psychiatric
8071 Medical Laboratories
8081 Outpatent Care Facilities
8072 Dental Laboratories
8220 Colleges, Universities, Professional Schools, and Junior Colleges

	8922	Non-Commercial Educational, Scientific and Research Organizations
	9641	Regulation of Agricultural Marketing and Commodities

22. **Educational and Vocational Shops**

SIC	8210	Elementary and Secondary Schools
	8249	Vocational Schools, except Vocational High Schools, not elsewhere classified
	8331	Job Training and Vocational Rehabilitation Services
	9223	Correctional Institutions

23. **Wholesale and Retail Sales**

SIC	5160	Chemicals and Allied Products
	5191	Farm Supplies
	5198	Paints, Varnishes, and Supplies
	5230	Paint, Glass, and Wallpaper Stores
	5399	Miscellaneous General Merchandise Stores

APPENDIX B

MANAGEMENT METHODS FOR USED OILS

TABLE B-1

EXTRAPOLATED DATA FOR VERY SMALL GENERATOR MANAGEMENT OF OIL WASTES (GALLONS)

DISPOSAL ON-SITE
Oil Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government			154	205				820	4511	350				1102	2050	9282
Cleaning Agents/Cosmetics																
Construction			1133					3541	6912					7706		19292
Educational/Vocational	1356		839											699		2894
Equipment Repair								888								888
Furniture Manufacturing														674		674
Laboratories														3		2
Laundries															99	88
Metal Manufacturing								85						648		723
Motor Freight Terminals																
Other Manufacturing																
Other Services																
Pesticide Applicators				74												74
Pesticide End Users																
Photography																
Printing																
Vehicle Maintenance	14752		2579					14670	195026	4845				88206	149	320235
Wholesale/Retail Sales								68	96					2738		2902
Wood Preservers																
Total / Mgt. Method	19186		4784	279				39081	206549	8284				101979	2288	357186

TABLE B-2

EXTRAPOLATED DATA FOR VERY SMALL GENERATOR MANAGEMENT OF OIL WASTES (GALLONS)

DISPOSAL OFF-SITE
Oil Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government	539	1035						8879	1861					833	499	13238
Cleaning Agents/Cosmetics									8							8
Construction	28460	1419						12272	5275	85						47809
Educational/Vocational	6053	453						196	1677					713	280	8271
Equipment Repair								11682	782							12464
Furniture Manufacturing																
Laboratories	59							381	322					293		1855
Laundries																
Metal Manufacturing	78	136													17	232
Motor Freight Terminals								40								40
Other Manufacturing																
Other Services								66								66
Pesticide Applicators								247								247
Pesticide End Users	421															421
Photography																
Printing								68						141		209
Vehicle Maintenance	169515	2028			35282			801799	140623	14878				184500	66051	1414874
Wholesale/Retail Sales	2547							2457	55					8418		14477
Wood Preservers																
Total / Mgt. Method	207872	5069			35282			838886	150603	14881				195599	66836	1514109

TABLE B-3

EXTRAPOLATED DATA FOR SMALL GENERATOR MANAGEMENT OF OIL WASTES (GALLONS)

DISPOSAL ON-SITE
Oil Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government										100						100
Cleaning Agents/Cosmetics																
Construction									54800							54800
Educational/Vocational																
Equipment Repair																
Furniture Manufacturing																
Laboratories																
Laundries																
Metal Manufacturing																
Motor Freight Terminals																
Other Manufacturing																
Other Services																
Pesticide Applicators																
Pesticide End Users																
Photography																
Printing																
Vehicle Maintenance									57240							57240
Wholesale/Retail Sales																
Wood Preservers																
Total / Mgt. Method									112040	100						112140

TABLE B-4

EXTRAPOLATED DATA FOR SMALL GENERATOR MANAGEMENT OF OIL WASTES (GALLONS)

DISPOSAL OFF-SITE
Oil Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government	100							6125	2950					2800		11875
Cleaning Agents/Cosmetics																
Construction								10960								10960
Educational/Vocational																
Equipment Repair								1775								1775
Furniture Manufacturing																
Laboratories		879														879
Laundries																
Metal Manufacturing	85															85
Motor Freight Terminals																
Other Manufacturing																
Other Services																
Pesticide Applicators								1446		876						2322
Pesticide End Users																
Photography																
Printing	311															311
Vehicle Maintenance	1908				36160			145509	4293					5724	11925	207519
Wholesale/Retail Sales																
Wood Preservers																
Total / Mgt. Method	2384	879			36160			165818	7243	876				8524	11925	235806

APPENDIX C

MANAGEMENT METHODS FOR USED SOLVENTS

TABLE C-1

EXTRAPOLATED DATA FOR VERY SMALL GENERATOR MANAGEMENT OF SOLVENT WASTES (GALLONS)

DISPOSAL ON-SITE Solvents Only Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government	61			40		3		61	803	1				39	15	1814
Cleaning Agents/Cosmetics																
Construction				13				643	321					181		1138
Educational/Vocational		279		14		28										321
Equipment Repair			35					355								390
Furniture Manufacturing																
Laboratories																
Laundries						15		150							361	527
Metal Manufacturing		194						194								388
Motor Freight Terminals																
Other Manufacturing																
Other Services								22						22		44
Pesticide Applicators			21													21
Pesticide End Users																
Photography																
Printing																
Vehicle Maintenance	51		741			1023	81	1007	7260					2245	205	12583
Wholesale/Retail Sales														72		72
Wood Preservers																
Total / Mgt. Method	113	473	788	67		1069	81	2423	8389	1				2538	581	16509

TABLE C-2

EXTRAPOLATED DATA FOR VERY SMALL GENERATOR MANAGEMENT OF SOLVENT WASTES (GALLONS)

DISPOSAL OFF-SITE
Solvents Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government	499	326			36			394	119					46	72	1491
Cleaning Agents/Cosmetics																
Construction	4425							1221	636					32		9514
Educational/Vocational	954	112						14	335					28	33	1475
Equipment Repair	132							728	745					1065		2670
Furniture Manufacturing	97															97
Laboratories	48				1065			58	194					121		1486
Laundries	8058	430						301		782				9		9581
Metal Manufacturing	52	739												810		1601
Motor Freight Terminals																
Other Manufacturing																
Other Services	9															9
Pesticide Applicators																
Pesticide End Users	34															34
Photography		9														9
Printing														339		339
Vehicle Maintenance	6176	1081			2659			12277	3783	1345				5317	1268	33626
Wholesale/Retail Sales	20													72		92
Wood Preservers																
Total / Mgt. Method	20496	2997			3756			14963	5819	2127				7936	1394	96316

TABLE C-3

EXTRAPOLATED DATA FOR SMALL GENERATOR MANAGEMENT OF SOLVENT WASTES (GALLONS)

DISPOSAL ON-SITE
Solvents Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government										230						230
Cleaning Agents/Cosmetics																
Construction									2923							2923
Educational/Vocational																
Equipment Repair								266				586				852
Furniture Manufacturing																
Laboratories																
Laundries																
Metal Manufacturing																
Motor Freight Terminals																
Other Manufacturing																
Other Services																
Pesticide Applicators																
Pesticide End Users																
Photography																
Printing														113		113
Vehicle Maintenance							525	668	16695							17888
Wholesale/Retail Sales																
Wood Preservers																
Total / Mgt. Method							525	834	18818	238		586		113		22006

TABLE C-4

EXTRAPOLATED DATA FOR SMALL GENERATOR MANAGEMENT OF SOLVENT WASTES (GALLONS)

DISPOSAL OFF-SITE
Solvents Only

Industry Group	Hauler to Landfill	Generator to Landfill	Buried on Property	Disposed in open pit, pond, lagoon	Licensed HW Facility	Disposed in sewer	Disposed in septic	Recycled	Burned for fuel value	Incinerated	Injected into well	Filtering	Neutralization	Other	Uncertain	Total / Industry Group
Government	2050							1637		200				260		4147
Cleaning Agents/Cosmetics																
Construction								1461								1461
Educational/Vocational	1251															1251
Equipment Repair	43															43
Furniture Manufacturing																
Laboratories									879							879
Laundries	2138				1322			1143								4603
Metal Manufacturing										810						810
Motor Freight Terminals																
Other Manufacturing	19							1610								1629
Other Services																
Pesticide Applicators		64														64
Pesticide End Users																
Photography																
Printing	4520														311	4831
Vehicle Maintenance	7942				3935			14286						954	2433	29550
Wholesale/Retail Sales																
Wood Preservers																
Total / Mgt. Method	17963	64			5256			20137	879	1010				1214	2743	49268